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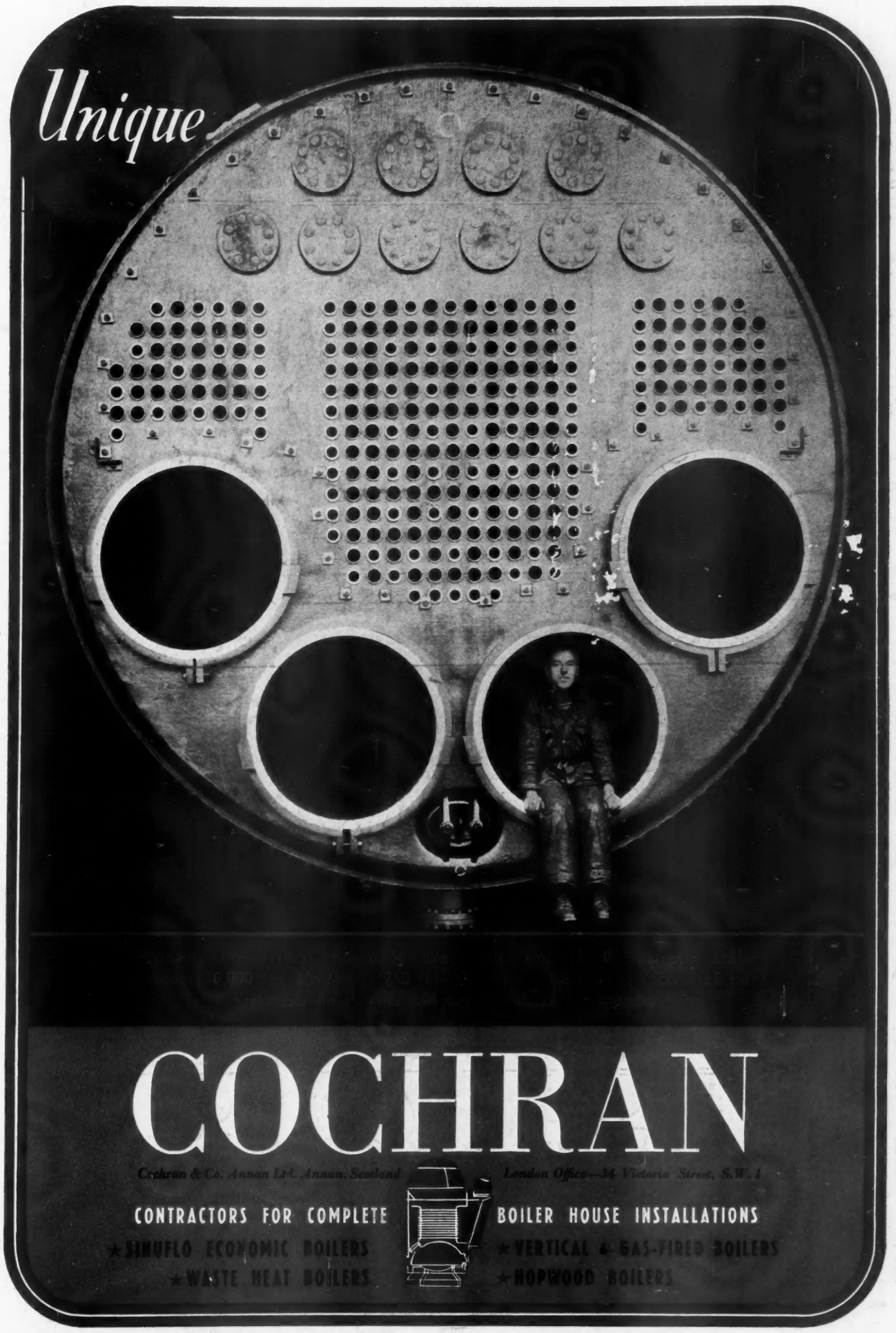

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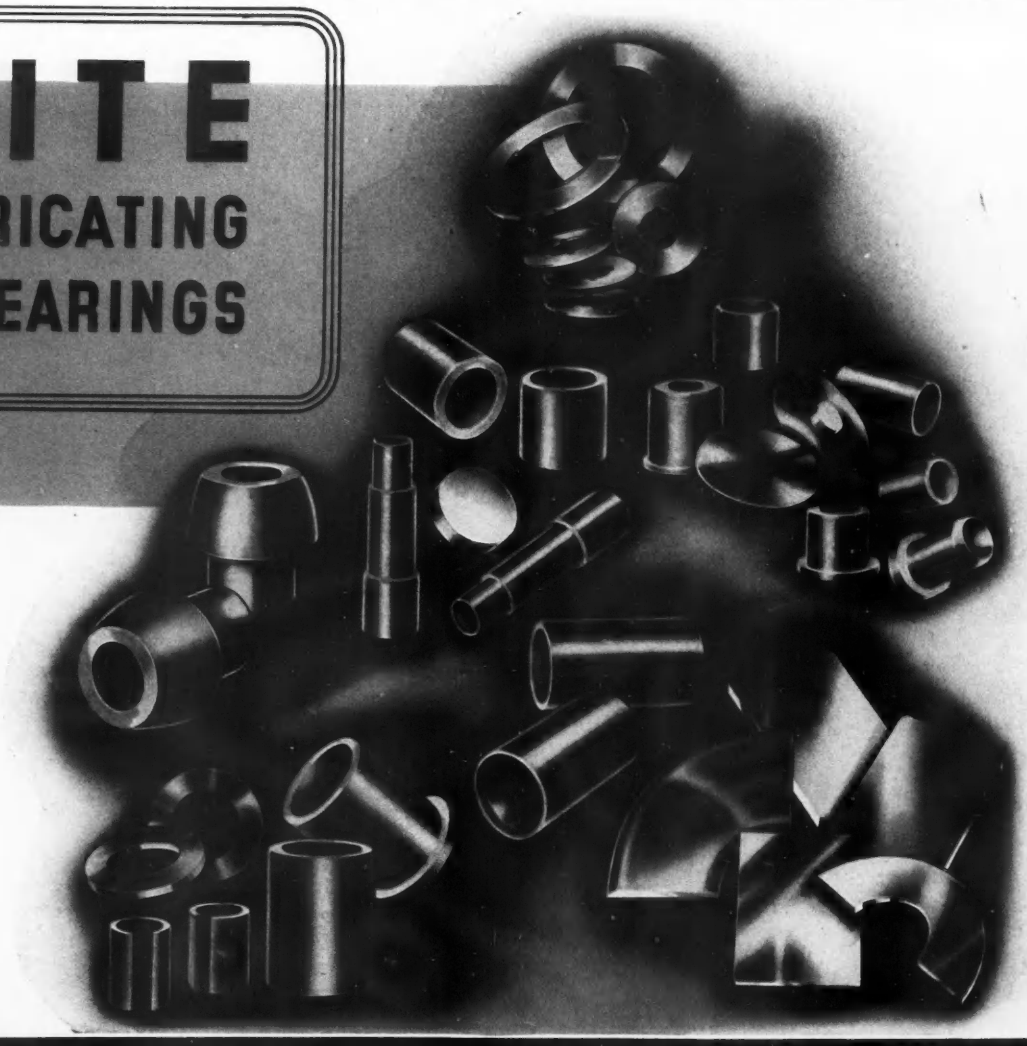

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Supply Area Organisations

As indicated recently in the House of Commons, area boards and advisory committees are being established throughout the country to assist in the development of industrial production for war purposes. The first of these bodies is to be set up in the Midland area with headquarters at Birmingham to-day, January 19th, and Mr. Leslie Burgin, Minister of Supply, is to entertain a number of prominent industrialists and representatives of employees' organisations at luncheon. The Lord Mayor of Birmingham is to be present. The members of the Midland area board are:—Engineer Rear Admiral H. L. Parry, C.B., O.B.E., Admiralty Engineer Rear Admiral F. S. Carlisle, C.B.E., Ministry of Supply, Mr. F. J. W. Hedgcock, A.M.I. Mech. E., principal inspection officer, Air Ministry, Mr. W. E. Barltrop, D.S.O., C.B.E., divisional controller, Midland division, Ministry of Labour. Mr. Phillip Handley, formerly of the Ministry of Labour, is secretary of the board. It is understood that Mr. Burgin at the luncheon is to outline the purpose of the committees and boards and indicate the valuable assistance expected to result from committees of employers and employees working in collaboration with the Supply Departments. The terms of reference of the area advisory committees have been widely drawn in consultation with representatives of the employers' and employees' organisations. Briefly, the committees are to advise the boards regarding efficient output, to assist in the survey of areas in respect of industrial capacity, and to make recommendations to the boards. At the same time it is made clear that both boards and committees will deal with questions of production and not with labour problems for which adequate machinery exists through the Ministry of Labour and the employers' and employees' organisations.

Thames Valley Land Drainage

At a meeting of the Thames Conservancy Board held on Monday, January 15th, Captain Jocelyn Bray presided. He said that land drainage in the Thames Catchment Area had assumed much greater importance since the war, having regard to its relation to food production. The five years land drainage programme, which envisaged the initial clearance of some 700 miles of main river, had been begun last April and was proceeding satisfactorily. By reason of the difficulty of getting labour, the full expenditure agreed between the Board and the county councils might not be incurred, but it would not be exceeded without consultation with the county councils. A committee report emphasised the necessity for the efficiency drainage, not only of land to be newly cultivated, but of all land, whether arable or pasture. It was felt that there should be closer association between the conservators and those concerned in organising and carrying out the war time cultivation of agricultural land. There was a great deal of misunderstanding by occupiers of land about the responsibilities of the conservators, with the result that the conservators were being blamed for the condition of streams for which they were not responsible. The Board could only deal with streams that were "main" river. A special committee was appointed to deal with the matter. Captain Bray said that some difficulties in the regulation and navigation of the Thames had occurred because a number of lock keepers had left for service with the Forces. A number of inspectors had also gone on service, but inspection to prevent pollution continued, and he believed that the purity of the river was as high as ever. The estimated income for 1940 of £117,350 was £14,650 below the 1939 figure, because of the anticipated decrease in the use of the river for pleasure purposes. The estimated expenditure was £14,233 less than last year, mainly because of the restriction of maintenance and dredging work.

The State as Trader

At a Ministry of Supply Press Conference held on Friday, January 12th, the foresight of the Government in ensuring that sufficient stocks of essential raw materials were ready to hand on the outbreak of war was commented on by Colonel J. J. Llewellin, Parliamentary Secretary, Ministry of Supply. He added that the State, through the Ministry of Supply, had become a trader in a very large way, and handled directly materials of the annual value of £150,000,000. The aim of the Ministry was to see that the stocks essential to our war effort were maintained, to buy such stocks at the best prices obtainable and to ensure that stocks were distributed in such a way as to secure their use for the needs most essential to winning the war. The Board of Trade Supply Organistion had been transferred to the Ministry of Supply on August 1st, 1939, and the Ministry had proceeded in its labours without any lack of continuity. Heavy air attacks and attacks by submarine or mine were anticipated, and the Government opportunely looked around to see what stocks of raw materials should be laid in. They enlisted the help of the trades concerned and were indebted to those who had laid in bigger stocks than they normally carried in peace time. The Government also bought considerable stocks of their own quietly and without any disturbance of normal markets or normal run of prices, and we actually started the war with large stocks of aluminium, zinc, antimony, silver, phosphate rock, and other materials. The Government had bought the whole aluminium output of Great Britain and the whole of the exportable surplus of Canada, and other large quantities. Steps were being taken to increase the production in this country and in Canada. It had also bought all the exportable surpluses of Australia, Burma, New Zealand, and certain foreign countries. In this case they were buying the materials and pooling their resources between Great Britain and France. Referring to the comparative steel position now and during the first months of the last war, Colonel Llewellin said that this country's steel capacity had gone up by 75 per cent. If they took the home and Empire production together, they found that it had increased from 9,000,000 tons a year at the beginning of the last war to 18,500,000 tons at the present time.

Shipping under War Conditions

At a general meeting of the Houlder Line, Ltd., held on January 11th, Lord Essendon, the chairman of the company, presided. In the course of his speech he said that the largely increased costs of construction would undoubtedly create a very difficult problem for the shipping industry to face after the termination of hostilities. The present situation was that neutral shipowners were reaping material profits owing to the high rates inevitably prevailing on account of the shortage of shipping space which a war invariably engenders. Profits on that scale had been very properly denied to British shipowners by the operation of controlled rates of freight. It was essential, in view of the Government requisitioning of all ocean-going tonnage, to make sufficient profit to maintain the British Mercantile Marine, and to continue our trades when the conflict was terminated. It was equally important that the shipping lines should be in a position to maintain their organisations ashore and afloat—organisations which had taken many years to create and develop. He readily conceded one necessity—that any additional earnings should be largely set aside for the replacement of tonnage, not only tonnage lost during the war, but tonnage that was worn out, or unfitted by reason of insufficient speed or other disabilities to meet effectively the enhanced competition which British liner companies would have to face when the war was over. Then the shipping industry would enter into another kind of conflict, which would last for a much longer period, and for which it would require all its reserves. Suspension of the Government assistance proposals, which would have involved a sum of well over £20,000,000, and the Government requisitioning of vessels, necessitated that the Government hire of vessels should pay for their costs, depreciation, and interest on capital, and something additional for replacement. If the profits were not to be greater than those that were earned prior to the outbreak of war, there could only continue to be a decline of the industry.

Excess Profits Tax

The Federation of British Industries has prepared a Memorandum on Excess Profits Tax and forwarded it to the Chancellor of the Exchequer. While the Memorandum has been drawn up in consultation with affiliated trade associations and represents the considered opinion of the Federation as a whole, points of particular concern to individual industries will be brought to the notice of the Chancellor independently. When the Chancellor of the Exchequer imposed the Excess Profits Tax in the Emergency Finance Act last autumn, he said that, although it was desired to pass it at once, there would be time before the normal Budget in the spring for the consideration of any amendments. It is with this statement in view that the Memorandum has been drawn up. The war of 1914, when Excess Profits Duty was imposed, succeeded a time of mainly steady and profitable trade, whereas 1939 follows a period which to many industries brought sub-normal or greatly varying trade conditions. The Federation feels that this difference in circumstances between 1939 and 1914 makes it most necessary that the reliefs available to the taxpayer for Excess Profits Tax should be at least as great as were deemed just for Excess Profits Duty. Amongst other points, the Federation wishes to see repeated the discretionary powers, in connection with various points, which, under the old Excess Profits Duty, were granted to the Commissioners of Inland Revenue. These powers led to a great measure of fairness and uniformity of treatment between different taxpayers. For example, the cost of plant which is provided for war purposes and which will be useless afterward, must be met by depreciation allowances. Such allowances in the last war were within the discretion of the Commissioner. It is a matter of great importance, the Memorandum urges, that these allowances should be adequate, or manufacturers will be involved in heavy loss.

British Motor Vehicle Exports

The Society of Motor Manufacturers and Traders announces that British motor vehicle factories exported 300 vehicles on each working day during November, the third month of the war. This figure was an increase of 26 per cent. over that for November, 1938. During the first three months of the war British exports of motor vehicles to Australia, India, and Burma, Portugal, and Uruguay were in each case records for the three months ended November of any year in the history of the industry. During this period exports of cars to Uruguay increased by 536 per cent., and those to Argentina by 172 per cent. The following percentage increases were also registered:—Ceylon, 123; India, 81; West Indies, 80; Burma, 42; Portugal, 40; Eire, 35; Malaya, 35; Australia, 31; Canada, 20; and South Africa, 18. It is pointed out that British motor manufacturers have increased their exports in spite of serious reductions in the consumption of new vehicles by New Zealand and Scandinavia. The New Zealand Government has, however, announced that the Dominion's purchases of motor vehicles will now be made only from the United Kingdom.

Scrap Metal Survey

It has been decided that the survey instituted by the organisers of the national campaign for the collection of scrap iron and steel is to be carried forward stage by stage until every possible field has been covered. In the opinion of the organisers of the appeal for scrap material there must be large quantities still awaiting recovery. First launched in the late autumn, the appeal was started by a direct approach to 15,000 industrialists by letter, resulting in the yield of about 80,000 tons of useful iron and steel scrap material. The appeal was not limited to urban centres, but was extended to some agricultural areas; with the co-operation of the National Farmers' Union, a special test survey was made in Gloucestershire. This test has proved so successful that a similar survey is to be made of all agricultural counties. Farmers and landowners in the more remote districts are being invited to lend every assistance within their power, for it is felt that much useless scrap must be lying derelict along hedgerows, in fences, barns, stables, and other outbuildings, as well as in cellars and attics.

Engineering and the War

Although the engineering employers will require some time to consider the case of the unions for an increase of wages of 10s. a week and to prepare their reply, an immediate statement made to the unions by Sir Alexander Ramsay draws attention to considerations other than the rising cost of living. Sir Alexander is the director of the Engineering and Allied Employers' National Federation. Without prejudging the arguments of the unions, Sir Alexander pointed out grave general reasons why the engineering industry should try to discover a policy to safeguard it from the dangers of inflation. Not only the engineering industry, but industry after industry had been virtually turned over to wartime purposes. Because a large part of the industry was working for the war, it was out of the financial resources of the country, or from borrowed money, that increases in the cost of production must be met. Engineering was a vital industry and neither the unions nor the employers wanted to create a situation which might ultimately react hardly on the workers. Any idea that there were illimitable resources from which the country could be financed was wrong. Individual taxation was at the highest point in our history and approaching the point of diminishing returns where further increases would react unfavourably upon employment and continuance of contracts. We had an economic alliance with France. The standards of the French worker were much lower than the standards in this country. France had 5,000,000 men mobilised and had adopted industrial expedients that we had not come to. He was not suggesting that this country should accept French conditions, but when there was an economic alliance based on restriction in one direction and the possibility here of the uncontrolled conditions of 1914–18, a strain was put on economic collaboration which might affect the ultimate war issues.

Two Dams in Mexico

A CONSIDERABLE effort has been made by the Mexican Government in the past few years in the matter of irrigation of desert land, not only in an attempt to increase fertility of the land, but also to provide electric power. Two of the most recent of the works carried out for this purpose are the dams at Salinillas Lake in Nuevo Leon, and at Madero, Hidalgo. Both were built under the direction of Senor Francisco Vazquez del Mercado, the Executive Commissioner of the Mexican National Irrigation Commission. This article is based upon information provided by Senor Arturo Sandoval, engineer to the Comision Nacional de Irrigacion of Mexico.

The dam at Salinillas is built to take advantage of the drop in the main irrigation canal of the Don Martin district into Lake Salinillas. The lake itself provides a storage reservoir with a capacity of 15,000,000 cubic metres (12,100 acre feet), and supplies both the demand for energy and that for irrigation water. The flow taken from the lake is 5 cubic metres (178 cubic feet) per second for power purposes. This flow can be doubled during the irrigation season, which is about 230 days per year, to provide irrigation water also.

The plant has two independent units, each with a double runner, horizontal shaft Francis type turbine, discharging into an open tailrace. They provide a capacity of 1000 HP at 360 r.p.m. Directly connected to these turbines are 865 kVA, 440-volt, 60 cycle three-phase alternators.

The energy generated is delivered to Ciudad Anahuac in Nuevo Leon, the urban centre of the Don Martin irrigation district, situated 25 miles from the plant. The transmission line, built on 10 m. (33ft.) concrete poles spaced 50 m. (170ft.) apart, is built for 33,000 volts with a sub-station at each end. The line is composed of No. 2 gauge steel aluminium wire.

The construction of this plant will permit the obsolete and insufficient thermic plant formerly installed at Ciudad Anahuac to be taken out of service. It will, moreover, permit a development of the preparation of cotton seed, one of the important products of the district. Another important feature of the work is that it has permitted the reduction of the cost of current at Ciudad Anahuac from 7 to 4 centavos per kWh. The total cost of the work was 600,000 pesos. The machinery in the plant is all German, the turbines being Voith constructed, and the generators A.E.G. Illustrations of this plant, reproduced on page 64, show the upstream side of the two-head intake gates at the end of the transition section of the canal; and the power-house and outdoors sub-station from downstream.

The dam at Madero—shown herewith, and on page 64—is built at a point known as Purgatorio on Hondo Creek, an affluent of the Moctezuma river. It provides a reservoir, in the creek valley, of 25,000,000 cubic metres capacity. The site selected is a gorge, 42 m. (139ft.) wide at the bottom. The geological formation is a rhyolitic tuff which is very soft in the upper part of the formation, and increases in hardness and bearing capacity towards the bottom. Cracks are to be found in it, but they close as the depth of the formation increases. The construction work comprised three main parts: a diversion tunnel, which serves also as an outlet for the reservoir, a main dam, and a spillway.

The diversion tunnel is situated in the right cliff, and has a cross-sectional area of 12·7 square metres (138 square feet) for a length of 172 m. (572ft.). Excavation for the whole length of the tunnel was carried out at a sufficient depth to permit the tuff to be tunnelled without the need for shoring. This tunnel was used during the construction of the rest of the work as a diversion channel for the flow of Hondo Creek, but on completion of the dam, outlet controls were installed in the tunnel. They comprise two valves, a butterfly type and a needle type, in a 34in. diameter steel pipe installed in the tunnel. This pipe runs through a concrete plug which blocks the tunnel near its upstream end, the butterfly valve being placed immediately below the plug at about 200ft. from the tunnel inlet, and the needle valve at the outlet end of the tunnel. The pipe, with its valves, permits a regulation of the flow of water for irrigation purposes.

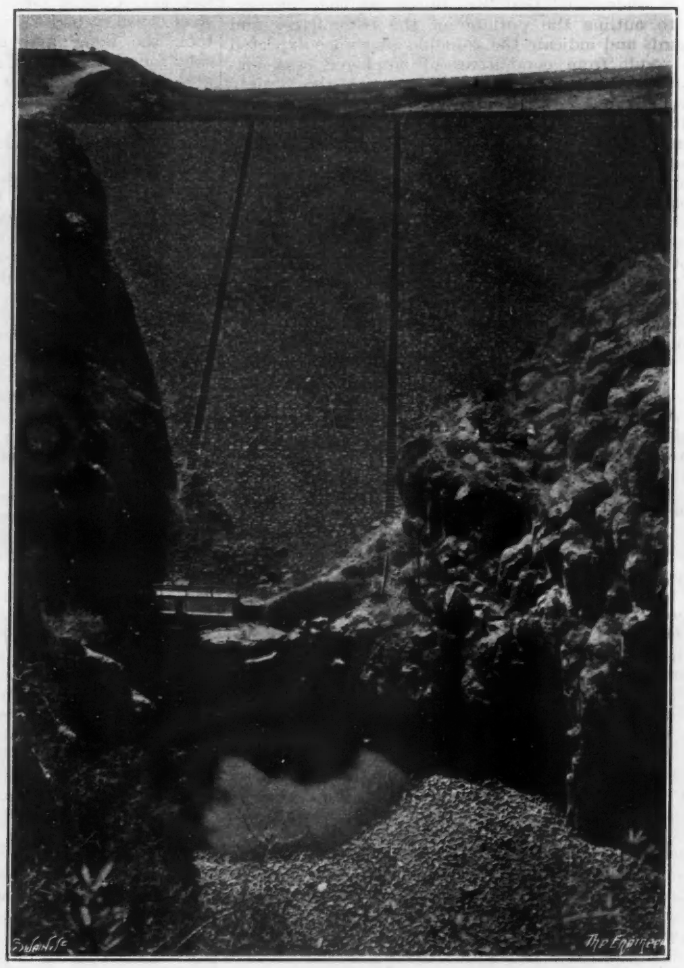
The dam itself is of the rock-fill type, and may be considered as consisting of three principal zones: a drop rockfill, a hand-laid rockfill, and a concrete facing which provides watertightness. The height of the dam above the bed of the creek is 48 m. (159ft.). Its upstream wall has a slope of 1·4 : 1, and its downstream wall a slope of 1·2 : 1. Crown width is 5 m. (16·2ft). The hand-placed rockfill was laid over the dropped rockfill. Over the rockfill reinforced concrete slabs are placed—see the engravings reproduced on page 64 and herewith.

These slabs are supported on the hand-placed rockfill, and vary in thickness from 43 cm. (17in.) at the base of the dam to 25 cm. (10in.) at the top. The slabs take the form of panels, 4 m. by 5 m. (13·1ft. by 16·2ft.), resting on reinforced concrete beams which are embedded in the hand-placed rockfill. Sheet copper expansion joints seal the spaces between panels, while permitting free expansion of each panel. Additional watertightness was provided by caulking the joints with tar impregnated Celotex strips. Reinforcement of the panels is obtained by the use of reinforcing rods, space 30 cm. (1ft.) between centres to form a network.

At the sides and bottom, the concrete panels connect with a concrete cutoff wall poured in a trench dug in the rock to varying depth, according to local requirements. Below this wall a cement grout curtain was formed by forcing grout into holes drilled to 30 m. (100ft.) depth. The joint between the concrete cutoff wall and the concrete slab panels is, like the joints between panels, formed of sheet copper and tar impregnated Celotex strips.

A free crest spillway is provided in a small saddle on the hillside forming the left bank—see page 64. It discharges into a small tailrace which returns the water into the creek at a point about 600 m. (2000ft.) downstream from the bulkhead. The spillway is 50 m. (162ft.) long, supported on its upstream side on a cutoff wall, 2 m. (6·6ft.) deep. It continues in a discharge channel of variable slope and section, and about 120 m. (400ft.) long. All this part of the spillway is lined with concrete. The spillway is designed for a maximum flow of 600 cubic metres (20,000 cubic feet) per second.

UPSTREAM SIDE OF MADERO DAM



DOWNSTREAM SIDE OF MADERO DAM

Harbours and Waterways in 1939

No. II

(*Continued from page 33, Jan. 12th*)

EUROPEAN PORTS AND WATERWAYS

(*continued*)

Holland

THE Pernis oil-basin on the south side of the Nieue Maas at Rotterdam, which was first opened in 1935, is in course of extension. A new arm, 1801ft. long and 820ft. wide now being added to the existing basin will increase the water-area by about 35 acres. The basin is not far from the open sea and much lower down the river than the old oil-basin which was the principal centre of the oil trade in the port up to 1935. In 1938, Rotterdam handled 2,800,000 tons of mineral oils, and, when the Pernis extension is completed, the port will have an aggregate oil-storage capacity of about half a million cubic metres.

Baltic and Scandinavian Ports

The storm of war that has swept over a large part of north-western Europe has rendered obsolete much of the information concerning developments in Baltic and Scandinavian ports that was available earlier in the year. It must suffice to mention briefly some of the projects that were under consideration during the first half of 1939. The Lithuanians had apparently decided, after the transfer early in the year of the port of Memel to the Reich, to develop the small fishing port of Shventai near the Latvian border as a port for overseas trade to take the place of Memel.

The Polish Government had already taken steps to increase its investments in the port of Danzig and to undertake considerable development work in the harbour of Danzig, in addition to the extension of the purely Polish port of Gdynia which, since its capture by the Germans, has been renamed by them Gottenhafen.

In accordance with the scheme of reconstruction under the Third Five-Year Plan, the Soviet Government proposes to construct a river-port at Leningrad which, it is said, will, when it is completed, be one of the largest river-ports in the world. The works proposed include seven miles of wharves and quays, mechanised loading and unloading plant, warehouses, and transit sheds and a large passenger station to be built on the river Neva. According to the Soviet authorities, the new port will be completed in 1942.

Italy

The building of the new dry-dock at Genoa, begun in March, 1936, is now virtually completed. This dock, known as No. 4, is the largest dry-dock in Italy. The dock has been made, not by excavation in the dry, but by sinking large reinforced-concrete caissons in the harbour area to the south-west of the Guardiana mole. The caissons forming the walls were sunk under compressed air, and most of them have a length of 20 m. The side walls and gate platform, including the jointing between the caissons, were completed in April, 1938. Shortly afterwards, the entrance was closed by placing the floating gate in the outer recess, and the construction of the concrete floor of the dock was proceeded with, the side walls being strutted apart by means of reinforced-concrete strut beams before dewatering was carried out. Some difficulty was experienced in dealing with the inflow of water from fissures in the underlying rock; but in spite of this the dock floor was completed early in 1939. The dock, when it is completed to its full intended length, will be 350 m. long and 40 m. wide internally, with a depth of water over the sill of 13 m. At present the available length internally is 280 m. only.

The Italian Government are carrying out port improvements at San Antioco on the south-west coast of Sardinia. The works are connected with the development of the local mineral resources, including coal, of which it is hoped to ship at the port three million tons annually. The scheme comprises a deepened entrance channel 2100 m. in length, a breakwater 600 m. long, and a large basin with wharves and quays. The depth in the basin and approach channel is to be 8 m. The project, including railway construction between the new port and the mines and other works, is estimated to cost over 17 million lire.

Rumania

King Carol of Rumania inaugurated, on August 15th, the work of constructing a new harbour at Tashaul on the Black Sea about 13 miles north of Constantza. The new port is intended both for commercial shipping and naval purposes: its use when it is available will relieve the congestion in the port of Constantza which, it is stated, constitutes an ever increasing difficulty. The harbour will be formed in part in the lake or lagoon of Tashaul which is at present separated from the sea. Entrance moles will be built, a cut made from the sea to the lake, dredging operations will be undertaken and quays built.

Spain

Many Spanish ports suffered severe damage during the two years of civil war which devastated the country. In the south and east of Spain the damage done to port works was particularly severe, notably at Barcelona, Valencia, Cartagena, and Alicante. At Barcelona there were, it is said, no less than thirty ships lying sunk in the harbour when hostilities ceased. The Franco Government have announced their intention to undertake a large programme of improvement and development work, not only at the major ports, but at a number of the smaller ports of Spain.

The programme of public works adopted by the Government provides for an expenditure of 703 million pesetas on port reconstruction and improvements. No doubt this expenditure, large for an impoverished country, will be spread over a relatively long period: at the present rate of exchange (38 pesetas=£1) it represents 18½ million pounds. At Bilbao the works commenced before the war are to be completed, and a new inner basin is to be made; at Cadiz the dry-dock, begun some years before the civil war, is to be completed; the harbour of Valencia is to be largely reconstructed; large expenditure is contemplated at Vigo and Corunna, and harbour improvements and extensions are to be made at Palma and in the Canary Island ports.

European Inland Waterways

The opening of the Albert Canal to through traffic between Liège and Antwerp, which was planned to take place in the presence of the King of the Belgians in July, had inevitably to be postponed on account of a serious mishap which occurred on June 26th, 1939. A section of the canal embankment near Hasselt collapsed almost without warning, and a breach in the embankment some 600 yards long was made through which the water of the canal rushed and flooded a considerable area of the surrounding country. The lives of at least three persons were lost as a result of the accident. The repair of the breach has been put in hand, but the date of the formal opening of the waterway has not yet been announced, nor have we yet seen any official explanation of the cause of the disaster.

It will be remembered that this canal has been constructed at a cost which will probably considerably exceed £14,000,000. Barges and ocean-going vessels up to a maximum of 2000 tons deadweight capacity will, when the through waterway is opened, be able to traverse the canal between Antwerp and Liège in two-and-a-half days. Several of the important works on the canal were illustrated and described in three articles published in THE ENGINEER in the latter half of May, 1935.

Shortly before the outbreak of war it was stated that the Belgian Government proposed to build another canal, on a scale approaching that of the Albert Canal, between Brussels and Charleroi. This work would incorporate parts of the existing canal between the two cities and involve the construction of new locks for vessels of 1350 tons capacity and the widening, deepening, and straightening of the old waterway.

The annual report of the Compagnie Nationale du Rhône, which was issued in June, indicated that there was to be some increased expenditure in the year 1939–40 on the improvement of the navigation between Lyons and the Mediterranean. Nothing has yet been done to make the Rhône navigable between Lyons and the Lake of Geneva; partly because the French Government are unable, at present, to fix the amount of their participation in the cost, and furthermore, negotiations with Switzerland are still in progress in regard to the dimensions of barges that will navigate the proposed new waterway. In any case, nothing effective can be done to provide for navigation on the upper reaches of the Rhône until the construction of the Genissiat Dam is brought to completion several years hence. We described the work recently carried out on the construction of the dam in our issue of November 24th.

Early in the year, interest in the project for the construction of the Canal des Deux Mers, between the Atlantic and the Mediterranean, was revived in the French Press by statements that arrangements had been made with certain French, British, and Dutch financial interests to advance some £90,000,000 for the carrying out of this vast work. Whether this statement had any sound basis of fact may be doubted, but it may be said at once that the advent of war conditions must postpone indefinitely any consideration of such proposals by the French Government. The total cost of this huge canal project, which, if it should ever be realised, would be on a scale equal to that of the Panama Canal, is estimated by the promoters not to exceed £125,000,000. The length of the canal would be about 248 miles, its Mediterranean terminal being at a point to the south of Narbonne, while at the Bordeaux end the River Garonne would be utilised.

We mentioned in our review of a year ago that the system of international control of the lower River Danube by the European Commission of the Danube had been modified by an agreement between Great Britain, France, and Rumania, by which Rumania will, in future, control the execution of new works in the region of the Danube mouths and in the zone between Braila and Sulina. Italy adhered to the modification early in the year, when also Germany was re-admitted to participation in the European Commission. The transfer of the administration to the Rumanian Authorities took place on May 16th at Sulina. The Commission is still in being although all its property on the river and its power of collecting rates and taxes have been transferred to Rumania.

The Italian Government is said to be actively encouraging the construction of inland waterways in connection with the rivers Po and Adige; a credit of 600 million lire has been allocated for this purpose.

The Times correspondent at Budapest reported in November that Germany had been making every possible effort to increase the goods traffic from the Balkans to Germany on the Danube before traffic on the river is suspended by reason of the winter ice. For three or four months in every winter the river navigation is closed. Until such time as the Rhine–Main–Danube enlargement project is brought to completion traffic on the Danube is severely restricted by the small size of the barges which are able to navigate it, as well as by the insufficiency of barges available, particularly those constructed for the transport of petroleum in bulk. On the old Ludwig Canal, which still forms a part of the link between the Main and the Danube, traffic is limited to barges of under 100 tons capacity—where reconstruction has not been completed.

The information available as to the progress made with the construction of new and the improvement of existing inland navigations in the Reich during 1939 is scanty. New construction was, in the first half of the year at any rate, being carried on with great activity in the Rhine–Main–Danube region. The dates of the anticipated completion of some of the major works, set out in the progress review issued by the Reich Ministry of Communications in 1939 are as follows:—

The Rhine–Main–Danube waterway was to be completed in 1945; shortage of labour was, however, causing some delay with the work. The Neckar improvement, between Heilbronn and Stuttgart was also to be ready in 1945. The enlargement of the southern section of the Dortmund–Ems Canal was expected to be so far advanced by 1940 as to permit of it being used by the 1000 ton vessels of the Mittelland Canal. The northern section of this canal was not, however, expected to be completed before 1944. The canalisation of the Middle Weser from Minden to Bremen for 1000 ton vessels was planned to be substantially completed in 1942. This work is of importance to the "Hermann Goering" works

at Salzgitter and efforts were being made to hasten its completion.

The deepening of the Ems–Weser Canal for 1000 ton vessels which was being achieved by regulation of the water-level was expected to be realised early in 1940. It was reported that the low-water regulation of the Elbe had been delayed to some extent by shortage of labour. The large aqueduct bridge over the Elbe and the double canal-lift at Hohenwarthe which are being made as part of the eastern extension of the Mittelland Canal were due for completion in 1942. At Hohenwarthe the canal drops about 19 m. to the water-level of the Elbe–Havel Canal recently completed for 1000 ton barges. The date for the completion of the Masurian Canal in East Prussia was stated to be 1940.

Reports from Soviet Russia indicate that another canal project has been added to the revised programme of canal and waterway construction entered upon in 1931. This is the reconstruction of the Volga–Caspian Canal in the Volga delta. The channel is to be deepened and widened to permit moderate-sized oil tankers to proceed as far up the river as Astrakhan.

THE NEAR EAST

Turkey

We mentioned in our review of the year 1938 that the negotiations between Turkish bankers and the Export Credits Guarantee Department, relative to the Turkish loan to be devoted principally to public works, had been concluded, and that a credit of £16,000,000 had been granted to Turkey. Some part of this sum is to be devoted to the construction of new ports, including one at Tchatal-Agzi. Early in the year it was announced that a commission appointed by the Turkish Government had selected Tchatal-Agzi for early development, and that plans and surveys for the new port works had been made by Sir Alexander Gibb and Partners. The site of the new port is on the Black Sea about 15 miles from Zonguldak. It will serve the Turkish coalfields and iron and steel works now being built at Karabuk. The plans for the harbour include the building of two breakwaters 3000 yards and 700 yards long respectively. Later in the year it was reported that two German firms had secured the contract for a naval port and shipyard for Turkey at Gueljue on the sea of Marmora. The amount of the contract was said to be nearly 2½ million pounds.

Alexandria

In recent years schemes for the development of Alexandria Harbour have again and again been prepared, approved, and then held in abeyance or scrapped in favour of alternative proposals. The Egyptian Government's budget for 1939–40 does, however, include preliminary allocations towards the construction of a petroleum basin, the deepening of the entrance to the harbour, and the building of new customs sheds at Alexandria.

The latest project for the development of Alexandria Harbour was announced in the course of the summer by the Minister of Communications. He stated that the Government proposes to spend £3,000,000 on the improvement of the port. The Great Pass, the main channel into the harbour, is to be deepened; the construction of a large dry-dock and a new petroleum basin are included in the programme, as well as the extension of one of the breakwaters and additions to the quayage in the harbour. Up to the present there is no news of any works of magnitude having been begun by the port administration of Alexandria.

One of the large floating dry-docks formerly in use by the Admiralty at a home port was towed to Alexandria in the course of the summer and was moored in the harbour before the outbreak of war.

Iran

The Ministry of Communications at Teheran in May invited tenders for the construction of harbour works at Bandar Chahpour in the Persian Gulf.

Iraq

The Kut barrage was inaugurated on March 28th by King Ghazi of Iraq. This work has been under construction since 1924, Balfour, Beatty, and Co. of London being the main contractors.

Although the object of the barrage is mainly to regulate the supply of water from the river Tigris for irrigation, provision is made in it by the construction of locks for navigation on the river.

(To be continued)

Oil-Engined Rail Traction in 1939

No. II

(Continued from page 45, Jan. 12th)

The English Electric Company, Ltd.

IN the oil-electric traction field the year has seen the putting into service of 480 B.H.P. oil-electric locomotives built by the English Electric Company, Ltd., for Brazil, and of a number of oil-electric shunting locomotives ordered by the London, Midland and Scottish Railway Company. It is interesting to record that during 1939 the L.M.S. placed with the company a contract for further oil electric shunting locomotive equipments, bringing the total order for such locomotives up to 40 in number.

In our issue of July 14th, 1939, there appeared a full description of these locomotives. The general arrangement is clearly illustrated in the engraving, Fig. 10. The leading particulars are as follows :—

Total Weight	55½ tons.
Wheel Arrangement	0–6–0
Maximum tractive effort	35,000 lb.
Wheel base	15ft. 3 in.
Wheel diameter	4ft. 3in.
Length over buffers	31ft. 4½in.
Maximum speed	20 m.p.h.

The engine, generator, traction motor, control equipment, and air compressor for each of the locomotives are supplied by the English Electric Company, whilst the building of the mechanical portions and erection of the equipment are being carried out by the railway company. The power unit, Fig. 11, is an " English Electric " six-cylinder oil-engine directly coupled to a 250 kW D.C. generator, arranged for three-point suspension on the locomotive frame. The output of the engine is 350 B.H.P. at 680 r.p.m., and it is designed to run at fixed speeds of 680 r.p.m., 590 r.p.m., 465 r.p.m., and 350 r.p.m. The last-mentioned speed is that at which the engine idles, but the control is such that tractive power is taken at this speed on the first few notches of the controller.

In conjunction with engineers of the L.M.S. system, the English Electric Company has developed special control gear for oil-electric shunting locomotives to provide constant speed under varying load conditions. For example, when pushing a rake of wagons over the hump, the load may vary from 80 wagons at the start to two or three wagons when the rake is finally pushed over the hump. The essential requirement of this operation is constant speed and the new equipment is claimed to permit a variation of not more than ½ m.p.h. in the average speed of 1½ to 2 m.p.h. A speed recorder reading from 0 to 2 m.p.h. is provided in addition to the standard speed recorder for ordinary shunting duties.

Following on the successful running of the four-coach articulated oil-electric trains supplied to the Ceylon Government Railways in 1937, which we are informed are operating on a basis of 7000 miles per month, the Crown Agents for the Colonies placed a contract with the English Electric Company for further oil-electric railcars. The new order is for single cars, but the power equipment, consisting of a six-cylinder oil engine developing 180/200 B.H.P. at 1350 r.p.m., and

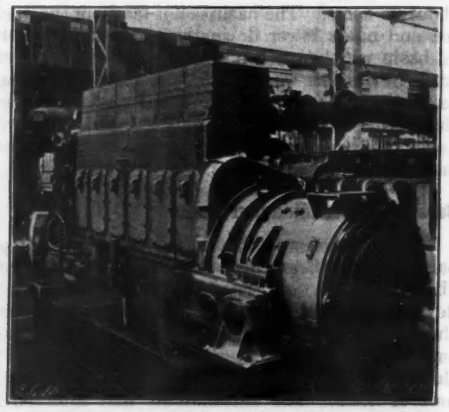


FIG. 11—350 B.H.P. POWER UNIT FOR LOCOMOTIVE

electrical transmission, will be interchangeable with the power equipments in the four-coach trains. Like the first order, the new coaches will be manufactured entirely in the company's works.

The Hunslet Engine Company, Ltd.

This firm had a very active year in the oil-engined locomotive field, and supplied many dozens of narrow and standard gauge locomotives of up to 60 H.P., both for home and overseas service. The latest development is the " mines" type of flameproof locomotive, as approved by the Board of Trade for working in gassy coal mines. This type of locomotive, of which already eight have been built, and many more are under construction, was fully described, together with the flameproof exhaust equipment fitted, in THE ENGINEER of September 8th, 1939. An accompanying engraving, Fig. 12, shows one of these locomotives, the first to work underground in British gassy coal mines. The whole mechanical design of the locomotive is remarkable in that complete equipment on every type is carried within a height of 5ft. and a width of 3ft. 4in., this width corresponding to a 2ft. rail gauge, although in actual fact the locomotive has been designed so that it can be built to 18in. rail gauge, when the

FIG. 10—OIL-ELECTRIC LOCOMOTIVE FOR L.M.S. RAILWAY

overall width would be 2ft. 10in. The engine develops 25 B.H.P. at 1300 r.p.m. and there is a mechanical four-speed transmission.

A considerable number of locomotives with powers ranging from 70 to 170 H.P. were built and put into service during 1939. One of the most interesting orders was that for four 3ft. gauge flame-proof locomotives for service in an oil refinery of the Anglo-Iranian Oil Company in the Near East. These locomotives are provided with six-cylinder National oil engines rated at 115/127 B.H.P. at 850 r.p.m., but developing, under the altitude and temperature conditions in Iran, a maximum of 106 B.H.P. Transmission is through Vulcan-Sinclair hydraulic couplings and three-speed gear-boxes. A maximum tractive effort of 9930 lb. can be exerted, which, with an adhesion weight of about 22 tons, gives a factor of adhesion of nearly 5 to 1. In the article in THE ENGINEER referred to above these locomotives were described.

FIG. 12—LOCOMOTIVE FOR USE IN GASSY MINES

Finally, the most notable locomotive produced during the year by these works is the supercharged 242 B.H.P. oil-engined locomotive for the Guaqui–La Paz Railway of the Peruvian Corporation. It was fully described in our issue of March 10th, 1939. We are informed that the results in service have more than come up to expectations, and that even at the highest altitudes, over 2½ miles above sea level, the locomotive has been running efficiently, and the oil engine has started readily. An accompanying engraving, Fig. 13, shows the locomotive leaving Antofagasta on the way to La Paz, over the Antofagasta and Bolivia Railway.

In full working order the locomotive weighs nearly 39 tons. The engine, supplied by Mirrlees, Bickerton, and Day, Ltd., is capable of developing 330 B.H.P. at a two-hour rating at 900 r.p.m. It is fitted with a Büchi supercharger, supplied by Richardsons Westgarth-Brown Boveri, Ltd., capable of increasing the engine output by 50 per cent. In practice the supercharger is designed to work most efficiently at the highest altitude, and in service the engine is derated. As the locomotive climbs the power available is reduced and at the maximum altitude of 16,000ft. the output is 242 B.H.P. Transmission of power is through a Vulcan-Sinclair hydraulic coupling followed by a Hunslet auxiliary gear-change and four-speed constant-mesh gear-box.

Drewry Car Company, Ltd.

During the year 1939 this firm completed an order for seven 3ft. 6in. gauge 0–4–0 shunting locomotives for the New Zealand Government Railways. These locomotives are fitted with Parsons petrol engines developing 75 B.H.P. at 1600 r.p.m., hydraulic couplings and Wilson-Drewry four-speed epicyclic gear-boxes. For the same railway system seven 0–6–0 locomotives, Fig. 14, were completed, but supplied without engines; Leyland 10-litre petrol engines were supplied by the railway. The transmission in this case is similar to the 0–4–0 locomotives, but correspondingly heavier. Pneumatic control of the gears is fitted, generally in accordance with the firm's standard practice.

Shunting locomotives of similar type and for gauges from 2ft. to 5ft. 6in. are under construction

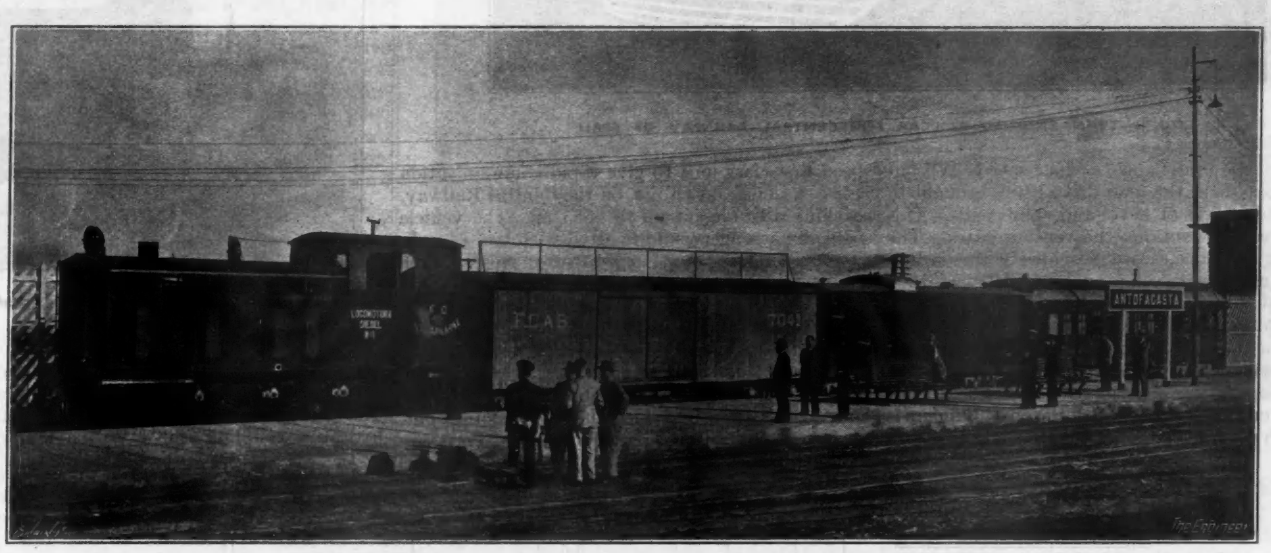


FIG. 13—242 B.H.P. LOCOMOTIVE FOR THE GUAQUI—LA PAZ RAILWAY, PERU

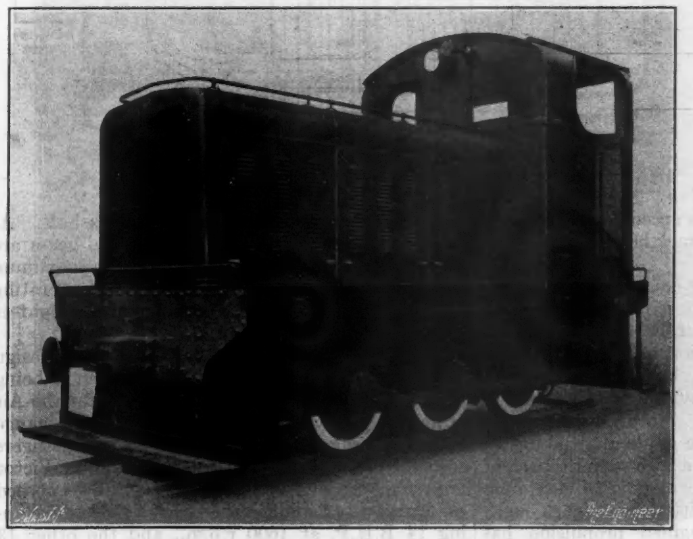


FIG. 14—0-6-0 LOCOMOTIVE FOR NEW ZEALAND

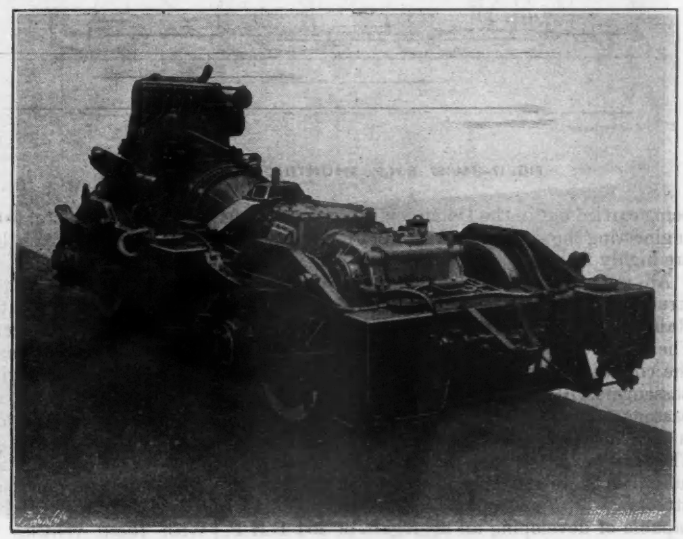


FIG. 15—POWER BOGIE OF RAILCAR FOR TASMANIA

for service in New Zealand, India, Zululand, and other countries. They are mostly fitted with 5 LW or 6LW Gardner oil engines and the standard combination of hydraulic coupling, Wilson Drewry four-speed gear-box and jackshaft drive.

The Tasmania Government Railways placed orders in Australia for the coachwork and trailing bogies of six railcars of 3ft. 6in. gauge, the order for the power bogies and control equipment being entrusted with the Drewry Car Company, Ltd. Two of these bogies, one of which is illustrated in Fig. 15, are fitted with Gardner 6L3 oil engines, capable of developing 153 B.H.P. at 1200 r.p.m., the arrangement being very similar to that adopted for the 99 cars supplied by the firm for the Argentine, which were described at some length in THE ENGINEER of March 25th, 1938. The drive is taken through a Vulcan-Sinclair hydraulic coupling and a four-speed Wilson-Drewry gear-box, the final drive being brought to one axle by means of bevel and spur gears. This final drive also contains the reverse gears. The remaining four bogies are provided with Gardner 6LW oil engines, developing 102 B.H.P. at 1700 r.p.m. and comparable transmission arrangements.

The combining of power bogies built in this country with coachwork built abroad is a new development and is stated to be very successful, the cars operating satisfactorily in service. The arrangement entered into with the coachbuilders is one which permits of a large proportion of the work being carried out in the Dominion, whilst providing engineering shops at home with work for which they are highly fitted.

An important order, constituted by the construction of four railcars for the Nizam's State Railway in India, was completed during the year. The cars are for 5ft. 6in. gauge, 67ft. 6in. long over the cowcatchers, and have accommodation for 84 passengers, 70 of whom are carried in the main passenger compartment, whilst at each end there is a "purdah" compartment for 7 women. The tare weight of the coaches is 37½ tons and the fully laden weight about 43 tons. Each car is fitted with two power bogies with Gardner engines capable of developing an aggregate of 204 B.H.P. By reason of climatic conditions, however, each engine is derated to develop 89 B.H.P., the total available horse power being therefore 178 B.H.P. The transmission is similar to that of the cars supplied to the Argentine. A notable part of the equipment is air-conditioning plant supplied by J. Stone and Co., Ltd. Dust-free air is kept constantly circulating at the correct temperature and relative humidity. Fresh air is mixed with a proportion of recirculated air and is delivered from an evaporator unit through grilles in the ceiling of the car. The air temperature is controlled by a number of thermostats.

D. Wickham and Co., Ltd.

Amongst the vehicles manufactured by this company during the year was a railcar, Fig. 16, which has been shipped to Peru and is undergoing trials there. This vehicle is designed as a high-speed first-class unit to give rapid communication between Lima and Oroya, on the Central Railway, reaching altitudes of up to 4585 m. The vehicle seats 52 passengers, and is fitted with two Lincoln twelve-cylinder supercharged petrol engines, one on each bogie. The drive is taken through Mylius four-speed gear-boxes and reverse gear units of Wickham manufacture. The neat arrangement of the driver's controls is illustrated in Fig. 19 herewith. We are informed that on test in this country the car easily maintained 100 kilometres per hour at less than one-third throttle opening, but, of course, conditions on the line in Peru are

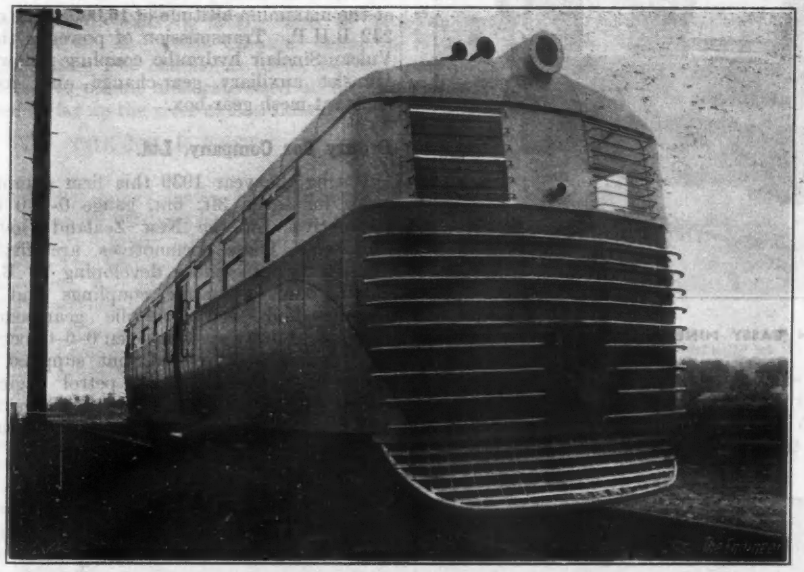


FIG. 16—TWIN ENGINED RAILCAR FOR CENTRAL RAILWAY OF PERU

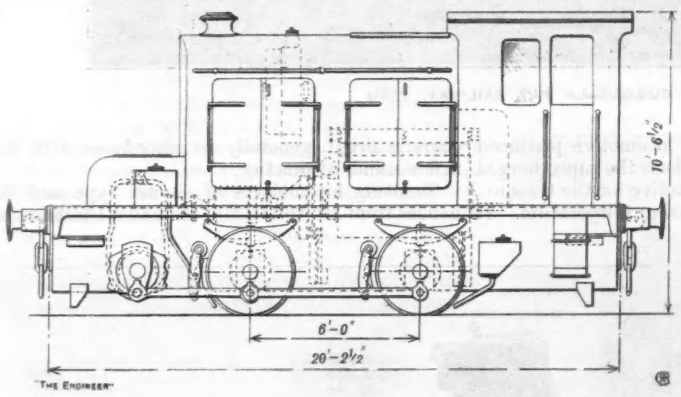


FIG. 17—144/157 B.H.P. SHUNTING LOCOMOTIVE

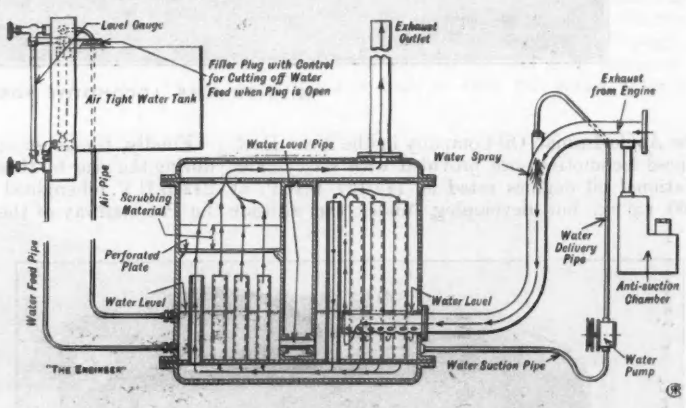


FIG. 18—SPARK ARRESTER FOR OIL ENGINE

six-cylinder engines set for the maximum of 65 B.H.P. at 1750 r.p.m. One axle of each bogie is driven through transmission comprised by a Mylius preselective air-operated gearbox and a final reduction and reverse gear of Wickham manufacture.

F. C. Hibberd and Co., Ltd.

For use in a Government ordnance factory this firm had under construction a 144/157 B.H.P. shunting locomotive of the "Planet" type, as shown in the accompanying outline drawing, Fig. 17. Power is supplied by a six-cylinder Davey-Paxman oil engine developing 144 B.H.P. at 1250 r.p.m. at continuous rating, with compressed air starting and a petrol auxiliary compression set. The transmission is through a Vulcan-Sinclair hydraulic coupling and a Wilson four-speed pre-selective epicyclic gear box to a jackshaft. At normal engine speed the speeds in the gears are 2·69, 4·72, 7·38, and 11 m.p.h., and the maximum tractive effort is 12,000 lb. at the twelve-hour rating of 157 B.H.P. In working order the weight is about 24 tons.

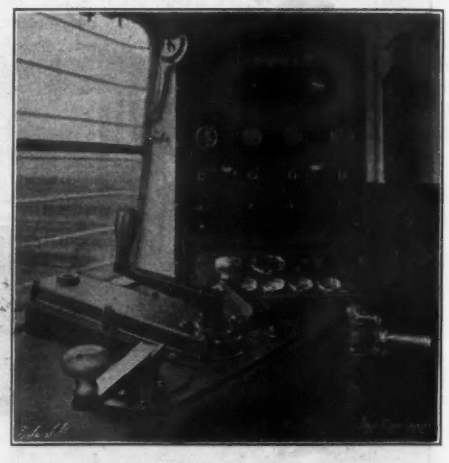


FIG. 19—DRIVER'S CONTROLS OF RAILCAR FOR PERU

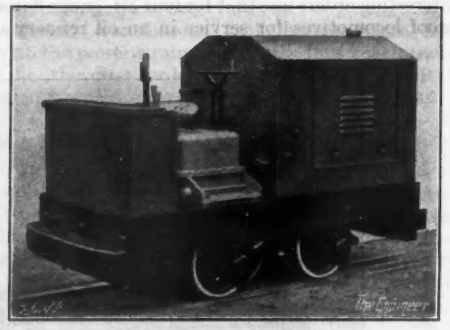


FIG. 20—20 H.P. LOCOMOTIVE FOR UNDERGROUND WORK

Other Government orders include a novel design of light oil-engined railcar, one of which is being constructed for the Admiralty and one for the Air Ministry. They are for 2ft. 6in. and 2ft. gauge and are suitable for 4 and 10 passengers respectively. In each case a Coventry-Victor twin-cylinder engine of the horizontally opposed pattern is fitted, that in the larger vehicle developing 14 B.H.P. at 1600 r.p.m., and the other 13 B.H.P. at the same speed. Straightforward

mechanical transmission with a unit construction four-speed gear-box is provided, operated from either end of the car. A particularly neat final drive and reverse unit has been designed by the firm, from which the axles are driven by chains. An interesting spark arrester equipment of Hibberd design and manufacture is fitted to these railcars and to many locomotives for work in dangerous areas. As is shown in the diagram reproduced in Fig. 18, water is circulated through a cast-iron tank with a gas inlet and tubes made of corrosion-resisting material and delivered in the form of a spray in the exhaust pipe, as near the engine as practicable, by means of a water pump driven from the engine. The exhaust gases are forced to take a circuitous path and are thereby cooled in the tank before passing through a scrubbing material to the atmosphere. An air-tight water tank is arranged to maintain the water level in the main arrester tank.

Of the many small and large shunting locomotives built by the firm during the year it is impossible to give full descriptions, but the 20 H.P. locomotive illustrated in Fig. 20 is typical of the types made. Eleven of such locomotives have recently been delivered for service on the New Zealand Government Railways. They are fitted with Perkins "Wolf" oil engines, developing 20 H.P. at 1100 r.p.m., and are designed for underground work on 3ft. 6in. gauge lines. Spark arresters and flameproof equipment are furnished.

(To be continued)

Shipbuilding and Marine Engineering in 1939

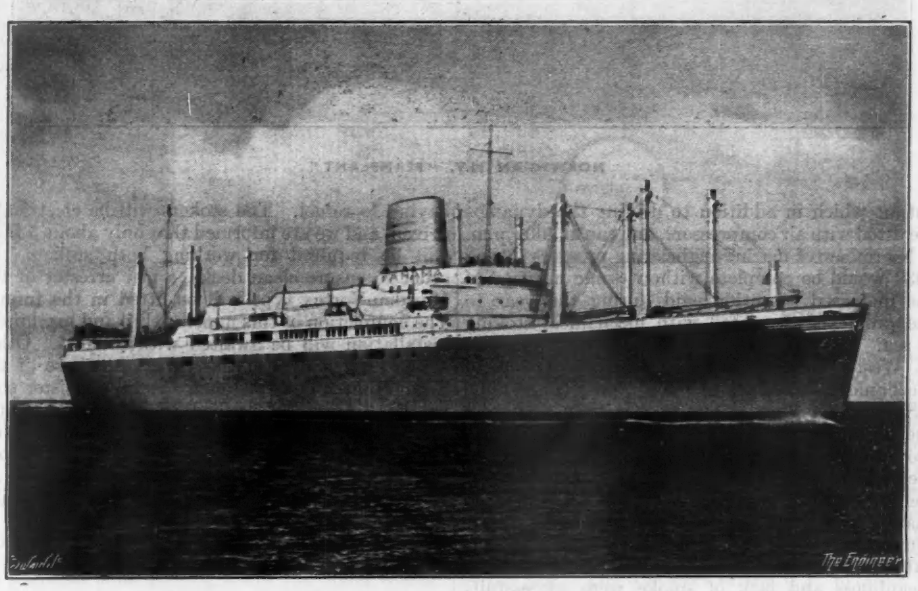
No. III

(Continued from page 48, Jan. 12th)

Some American Cargo and Passenger Liners *(cont.)*

AN outstanding passenger liner built in America during the year was the "Panama" (see accompanying illustration) which was constructed by the shipbuilding section of the Bethlehem Steel Company of Quincy, Mass., and in April sailed on her maiden voyage from New York, in the Canal Zone Service of the Panama Line. She is the first of three such twin-screw passenger and cargo liners to be completed, and has an overall length of 493ft. 6in., a beam moulded of 64ft., and a depth to the promenade deck of 46ft. 9in. Her designed loaded draught is 26ft., and her measurement is about 10,021 gross tons. The propelling machinery adopted for these three ships comprises cross-compound double-reduction geared turbines of Bethlehem design and manufacture, having a total designed output of 9000 S.H.P. at 90 r.p.m., taking steam from two Bethlehem three-drum "A" type double gas flow oil-fired water-tube boilers. The working pressure is 450 lb., and the final steam temperature 740 deg. Fah. The trials of this ship were successful, and at the high speed of 18·76 knots the turbines developed 9138 S.H.P. at 92.28 r.p.m. while the fuel consumption trials showed an oil consumption for all purposes of about 0·637 lb. per S.H.P. hour. She carries 202 cabin passengers, and a crew of 124.

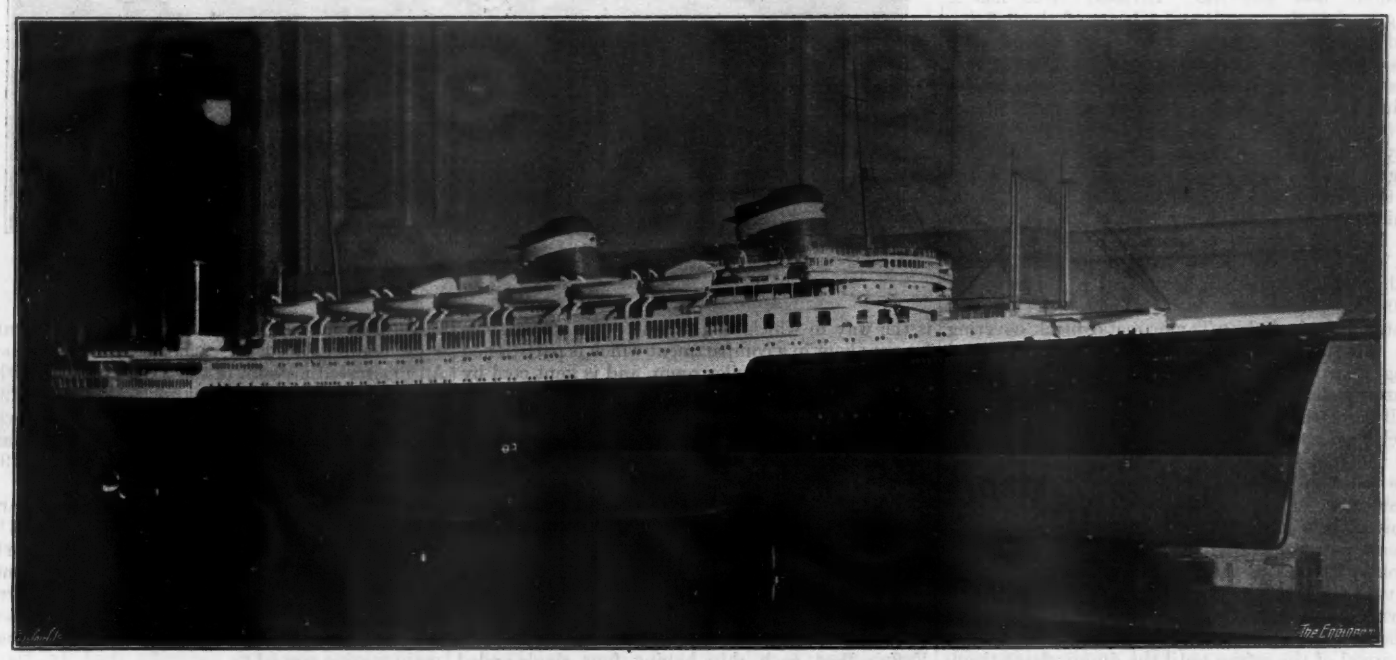
In an accompanying illustration, we show a view of the 15ft. model of the "America"—a twin-screw liner which was launched at the end of August from the yard of the Newport News Shipbuilding and Dry Dock Company, of Newport News, Va. This fine ship is claimed to be the largest yet built in America for mercantile purposes, and she is intended for the North Atlantic service of the United States Lines of New York, and will co-operate with the present liners in this service, the "Manhatten" and the "Washington." She is expected to enter service sometime this year. Her leading particulars are length overall 723ft., breadth moulded 92ft., and depth to A deck 45ft. She will have a gross tonnage of about 30,000, and will be fitted with twin-screw geared turbines, each consisting of one H.P., one I.P., and one L.P. turbine, made by the builders. The designed output of each set of propelling machinery is 17,000 S.H.P. at a propeller shaft speed of 128 r.p.m. The completion of this interesting liner will be awaited with interest by British naval architects and marine engineers.



PANAMA LINE STEAMSHIP "PANAMA"

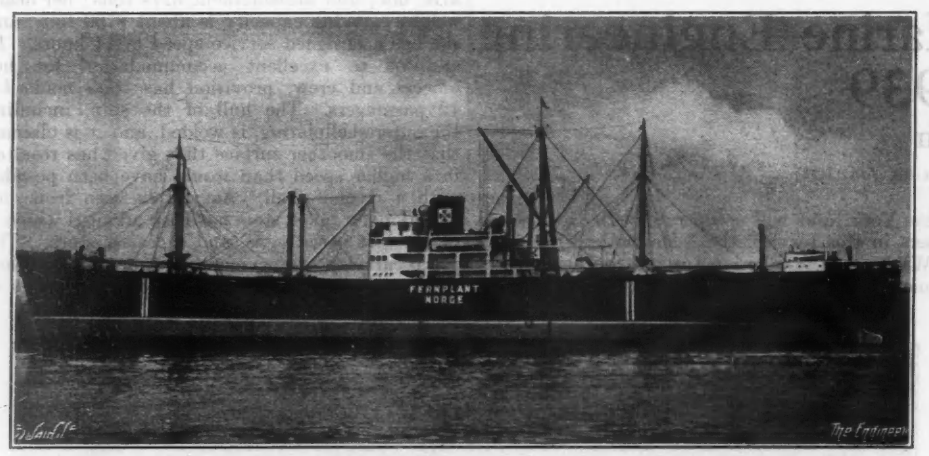
An Interesting Norwegian Cargo Ship

In our last article, we mentioned briefly the use of light alloy construction which has been adopted in the superstructure of the Norwegian cargo ship "Fernplant." A view of this interesting motor vessel is reproduced herewith. She was built and engined by Burmeister and Wain of Copenhagen for the Dampskibsinteressentskabet Garonne of Oslo. Her principle dimensions are as follows: length 415ft., breadth 56ft., depth to upper deck 37ft. 6in., and measurement 5274 tons; her deadweight carrying capacity is about 8700 tons, and she has a designed service speed of 14 knots. In addition to excellent accommodation for her officers and crew, provision has been made for 12 passengers. The hull of the ship, including the outer shellplating, is welded, and it is claimed that the smoother surface thus given has resulted in a higher speed than would have been possible with a riveted shell. As will be seen from our engraving, a raked stem has been adopted which is of the soft nosed type, and a cruiser stern. The cargo carrying arrangements include wide hatched holds served by derricks, and electric winches of Thrige design. Special interest attaches to the use of sea-resisting aluminium alloy for the upper deckhouses, the captain's house, and the chart-room, which includes the use of cast aluminium



MODEL OF UNITED STATES LINES STEAMSHIP "AMERICA"

sidelights and window frames. A considerable saving in weight has been affected by the use of light alloy, and an additional advantage claimed is the reduction of magnetic disturbance near the compasses. The propelling machinery marks a step in advance, as it includes an improved design of nine-cylinder cross-head type, two-stroke, single acting oil engine, for which a saving in height is claimed compared with earlier designs. The engine has a designed output of 5500 I.H.P. at 122 r.p.m. In weight it is only about 10 per cent. heavier, and 15 per cent. higher than the corresponding trunk-piston engine. The deck and auxiliary machinery is electrically operated, the power for this machinery and for lighting being obtained from a group of three B. and W. single-acting two-stroke engines of 180 B.H.P. output which in addition to driving the dynamos are fitted with air compressors, and run at 400 r.p.m.



NORWEGIAN M.V. "FERNPLANT"

No review of marine engineering progress during 1939 would be complete without some mention of the increased attention paid during the year to the problems associated with mechanical stoking at sea. Early in March the British Coal Campaign of Westminster organised a demonstration of mechanical stoking at sea, on board the "Shepperton Ferry," one of the train ferries of the Southern Railway Company operating between Dover and Dunkirk. This ship and her sister steamers, the "Hampton" and "Twickenham Ferries," are equipped with Yarrow boilers and marine type Taylor stokers. Small Kent coal is burnt on the grates of these boilers, and the extreme flexibility of the installation, and its cleanliness and lack of smoke were successfully demonstrated. In May it was officially announced that the Southern Railway Company had decided to entrust the construction of a sister ship to the "Canterbury" for the Dover and Calais cross-Channel service to a leading Clyde firm, and that coal firing with mechanical stokers would be adopted. The new steamer was launched in the autumn, and was the "Invicta." She has a length of 350ft. overall and a beam of about 52ft., and she will be designed to carry about 1300 passengers. The propelling machinery will comprise a twin-screw arrangement of Parsons single-reduction geared turbines taking saturated steam from two Yarrow water-tube boilers, fitted with Taylor marine type stokers. In an accompanying engraving we show one of the stokers in the works of the Taylor Stoker Company, Ltd. The boilers, which are being built by the main contractors to Yarrow designs, evaporate 70,000 to 80,000 lb. of water per hour from feed at 220 deg. Fah. into saturated steam at a pressure of 250 lb. per square inch. They will embody water walls including Taylor metal block covering on the furnace side of the tubes and patented slag drip construction above the block covered water wall surface. The forced draught system will be of the closed stokehold type. In addition each boiler furnace will be continuously sealed at the fuel supply end so that it will be possible to clean the fires or carry out ashing under reasonably effective conditions of furnace sealing. This work is accomplished by the incorporation of a steam power operated ash dump at the rear of the stoker, which tips the ash into an air lock, placed between the dump plates themselves and the furnace ash doors at the rear end of the grate. The furnace ash doors are not opened for the removal of the refuse until the dump plates themselves become sufficiently covered to produce a seal effect. By this particular design of ashing arrangement it should be possible to clean fires without loss of power while the ship is in service. The service under which these boilers will operate calls for special operating conditions and up to 10,000 S.H.P. must be released in a few minutes from the giving of the order to start, and on arrival at the other side of the Channel must be similarly checked in a very short time. Under normal schedule conditions the time of the crossing from starting to stopping will be not more than 75 minutes, and the arrangements made will enable steam to be quickly raised, even after the ship has remained stationary for many hours. The whole of the coal will be fed by gravity to the stokers, and the bunkers are of such capacity that the ship will be able to operate for about one week without having to refuel. The stokers will be electrically driven, and we are informed that only about 5 H.P. will be required for working both stokers. In order to ensure clean decks, a grit arrester of the Howden-Vortex type will be fitted in the funnel. The completion of this unusual ship and machinery installation will be awaited with interest. Other stoker-fired boilers of the year were those of the Swan-Hunter built steamer "Aska," a sister ship to the "Amra" described in last year's annual articles, which has joined the fleet of the British India Company in Eastern waters. She is equipped with high pressure 450 lb. Babcock boilers designed to give superheated steam at 750 deg. Fah., fired by Babcock-Erith retort-type stokers. A particular feature of the layout of the boiler room is the way in which all the motors for driving the fans are kept in a compartment which is partitioned off from the main boiler room, and is kept cool by the incoming air to the pre-heaters. An enclosed ashing arrangement serves to maintain a clean and cool stokehold. A third ship of the same type is now under construction on the Tyne. In Hong-Kong the Hong-Kong and Wampoa Dockyard is completing a sister ship to the "Mulubinba" for the Newcastle and Hunter River Steamship Company. This ship is also equipped with Babcock boilers fired with Babcock-Erith stokers. The same type of stoker applied to Scotch boilers has during the past year been fitted into the steamers "Samala" and "Mopan" of Elders' and Fyffe's fleet, each ship having four single-ended Scotch boilers.

MECHANICAL STOKER FOR CROSS CHANNEL STEAMER

Oil-Fired Boilers

We have already referred to the Royal Mail liner "Andes" which is equipped with three of the largest Babcock-Johnson boilers yet constructed. These were built by Harland and Wolff, Ltd., under Babcock licence. They are designed for a safety-valve blow-off pressure of 485 lb. per square inch, and a final superheated steam temperature of 750 deg. Fah. They are oil-fired and are fitted with Howden-Ljungstrom air pre-heaters. The 30,000 S.H.P. Parsons' geared turbines and the boilers above referred to make one of the lightest and most compact arrangements of propelling machinery ever installed in a merchant vessel. We regret that wartime censorship will not allow a further detailed description of this boiler room, which in its lay-out is without doubt one of the most remarkable ever seen afloat.

In an accompanying illustration we show one of the boilers of a new Clan Line steamer which is now in course of completion on the Clyde. The twin-screw turbine machinery of this ship takes steam from three standard Babcock units with Babcock oil-firing equipment. Two ships fitted with similar boilers, but arranged for conversion to mechanical firing if required were the Russian steamers "Josef Stalin" and the "Viaschelav Molotof" which have been built by the Netherland Shipbuilding Company of Amsterdam. These are modern ships with a designed speed of over 20 knots, and are intended for passenger, mail, and cargo service. The propelling machinery is turbo-electric, taking steam from four Babcock standard boiler units. Other ships fitted with Babcock boilers which were built in Holland for the service of the Anglo-Saxon Petroleum Company included the "Saidja" and the "Saroena," while several dredgers built in Holland and in Scotland for U.S.S.R. service were fitted with four standard Babcock boiler units. Of these the suction dredgers "Zeya" and "Onega" were built at William Simons and Co.'s Renfrew yard. At the Renfrew yard of Lobnitz and Co., Ltd., several dredgers were completed on both home and foreign account.

The past year was a particularly busy one for the development and further application of the Babcock oil burner, for water-tube, Scotch, and waste heat boilers in motor vessels. The introduction of the newly patented return flow system has enabled a very wide range of capacity to be obtained with a single burner. Individual installations included the conversion of the Union Castle Line's steamers "Llandaff Castle," "Llandovery Castle," and "Llanstephan Castle." This work was carried out at the Belfast yard of Harland and Wolff, Ltd., and the latest type of Babcock oil burning equipment replaced the earlier coal burning plant. An illustrated account of the "Llandovery Castle" installation will be found in our issue of May 19th, 1939. The burners for waste heat recovery boilers referred to above were supplied for large motor liners which went into service during 1939, and included Dutch and Italian ships.

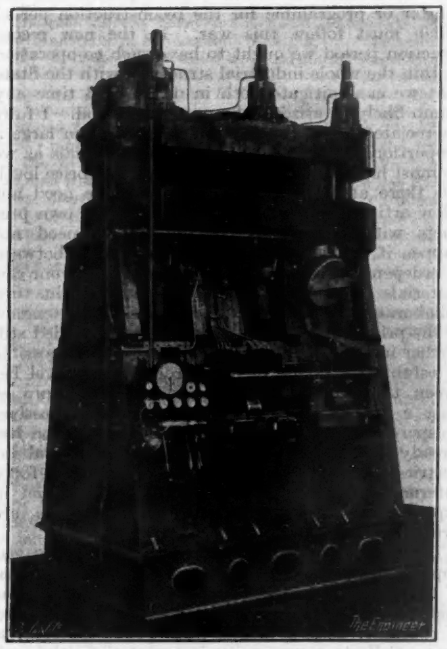
At the present time in common with other marine engineering firms the marine department of Babcock and Wilcox, Ltd., is busily engaged in the production of boilers and oil burning equipment for naval vessels, but this work is being carried on as far as possible without interfering with the mercantile marine service work, which is Babcock's main marine speciality.

A noteworthy feature of the boiler work carried

out at the Scotstoun works of Yarrow and Co., Ltd., during the year was the large amount of naval machinery under construction for foreign governments. Two destroyers complete with machinery were delivered early in the year to the Greek Government, and the boilers and turbines for a third ship, the hull of which will be built at the new Government shipyard at Skaramanga, is in hand. Machinery for a further three destroyers for the Yugoslav Government was completed and when trials were run a notable high speed of over 38 knots was recorded on the eight hours' continous trial. In addition to the marine work, a considerable amount of boiler engineering work for power stations and industrial works was completed.

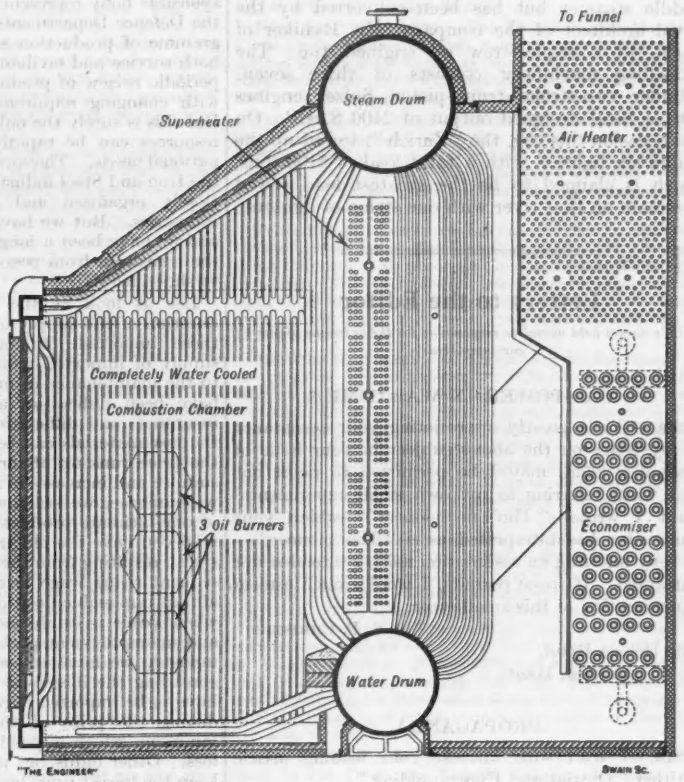
An event of the year was the inspection by British marine engineers of the new Foster-Wheeler

BOILER FOR NEW CLAN LINE STEAMER



ENGINE FOR S.S. "BATAVIER III"

"D" type marine oil fired boiler, which was installed in the United States liner "Challenge" already referred to in a previous article. The drawing herewith reproduced shows the general design and construction of this boiler, embodying a large water-cooled furnace in which oil can be burned at high efficiency without overheating. It will be seen that the boiler tubes are arranged vertically, connecting a top 42in. diameter steam drum, to a bottom 32in. diameter water drum. A convection superheater is employed which is screened from the fire, and it comprises an arrangement of six passes of 1¼in. tubes behind three rows of boiler tubes. The air heater is horizontal and consists of a nest of 1¼in. diameter tubes which are arranged eighteen wide and fifty high, having an effective length of 7ft. The economiser tubes are of similar effective length, and they are arranged five wide and sixteen high, and have a diameter of 2in., the tube being covered with cast iron gills. The main boiler tubes consist of three rows of 2in. tubes and thirteen rows of 1¼in. tubes. The furnace it will be seen is completely surrounded by water walls. It has a depth of 7ft. 8in., and a total volume of 704 cubic feet. Two boilers are neatly grouped in the ship in a single casing with the propeller shaft passing below the boiler casing. The weight of a single boiler, including the metal parts is 51 tons. The weight of the brickwork being 16½ tons and that of the water at the steaming level 5¼ tons, the total weight works out at 72¾ tons, an advantageous figure, for an installation comprising two boilers with a working pressure of 525 lb. per square inch and a superheated steam temperature of 765 deg. Fah. maximum designed to supply steam to 6000 S.H.P. geared turbine machinery.



ARRANGEMENT OF BOILER FOR UNITED STATES LINER "CHALLENGE"

Reciprocating Steam Engines

As in past years a large number of reciprocating steam installations were completed by the North Eastern Marine Engineering Company, Ltd., David Rowan and Co., Ltd., and John Kincaid and Co., Ltd., to name only three of the principal makers of this type of propelling machinery. No returns for these firms have been given, but we understand that the North Eastern Marine Engineering Company, Ltd., has had very satisfactory experience with its re-heater type of engine, which has now been in service for over three years, and has been operated at superheats up to 750 to 800 deg. Fah. with excellent results. New ground was broken by the Werkspoor Company of Amsterdam with the engine installed in the "Batavier III" already referred to. We show this engine in an accompanying engraving. It is totally enclosed and is equipped with Meier-Mattern oil-operated valve gear. There are three cylinders, one H.P. and two L.P. cylinders, arranged on cranks placed at 120 deg. The diameter of the H.P. cylinder is 650 mm. and that of the two L.P.'s 1000 mm. Steam is supplied at a working pressure of 250 lb. per square inch, and a final temperature of 590 deg. Fah. The engine is designed to develop its maximum output of 3000 I.H.P. at 125 r.p.m., and has a normal service rating of about 2650 I.H.P. with a corresponding steam consumption of 9·6 lb. per I.H.P. hour.

SWISS RHINE TUG "ZURICH"

Conclusion

The space available for this review has not made it possible to deal fully with all the interesting ships which during 1939 have been constructed in this country and abroad. Another ship which

calls for brief mention and to which we may return in a later article, is the French liner "Pasteur," which was built at St. Nazaire by the Société Chantier et Ateliers de Saint-Nazaire Penhöet, for the South American service of the Compagnie de Navigation Sud-Atlantique, and replaced the ill-fated "L'Atlantique," which was destroyed by fire. From Switzerland comes an interesting picture of the largest Rhine tug completed during the year for the service of the Swiss Towing Company, of Basle. It was originally a paddle steamer but has been converted by the naval architect of the company, Mr. Ryniker of Basle, to a triple-screw oil engined tug. The propelling machinery consists of three seven-cylinder two-stroke trunk-piston Sulzer engines with a total designed output of 2400 S.H.P. On one occasion this tug, the "Zurich", towed up the Rhine six lighters with a total load of 8100 tons, which is claimed to be the greatest load towed upstream on that river with one string of lighters.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

GAS POWER IN WAR TIME

SIR,—While greatly appreciating your acceptance of my letter on the above subject in your issue of December 22nd, may I be permitted to point out that when referring to my own small experimental plant I wrote—"Tho' no pioneer"—which your compositor has interpreted as —"The pioneer"—thereby inferring an assumption neither intended nor warranted. If space permits, I would much esteem the correction of this small error.

S. P. CHRISTIE

5, Helena Road,
Southsea, Hants.

PROPAGANDA

SIR,—I read with interest your leading article entitled "Output and Understanding."

The best piece of propaganda released by the Ministry of Information was in connection with the British submarine's exploits in German waters. This happened about two months ago, and you will remember that comment was made that if the shipyard rivetter had scamped his work the submarine would not have been able to stand up to the depth charges.

As a one-time shipyard worker myself, I know the encouraging effect that this will have had, so why cannot we have more of this kind of commentary covering the whole of our armaments industry.

J. R. KNOX.

Industry through War to Peace*

THE first thing about which all who went through the last war would, I think, be agreed is that both industry and the State are much better organised on this occasion than we were last time, both in their relations to each other and within themselves. At the same time, this being a democratic and not a totalitarian country and we being British, there are still a number of things we should like to see better and feel free to criticise. I am reminded by this reflection of an experience while travelling in America in 1912 when going through the Gary steel works, then the largest in the world, where I first saw Safety First notices. They were killing about fifteen men a month then and Safety First was just coming in. There were slogans all over the works and one of them said, "More trouble is caused by want of thought than by want of care."

In some of the difficulties with which we are confronted now I think it is not the quantity of thought but the right kind of thought that has been missing. As industrialists I wonder whether we are not in some measure perhaps responsible for the fact that the right kind of thought was not available at the right time. We are generally, as industries, much better organised than in the last war but not nearly so much so as I personally hoped we would be after 1918. In war we have to deal with a large number of detailed problems in relation to our own production in meeting the demands, first, for military purposes and, second, of the community to maintain our daily national life. Each of these problems is conditioned by some direction or control which in the interests of the military effort of the State have been imposed upon us. Those who impose control upon industry in the interests of the military effort naturally have one idea in their minds and that is the production of the requisite military potential to be effective at the right time. Very often those charged with that responsibility can have little or no knowledge of the industrial machine into which they are quite unconsciously throwing spanners and monkey-wrenches. When I hear criticisms that that is happening I wonder how much are we industrialists responsible, and I think in a large measure perhaps we are responsible. Because though our organisation is much better, it is really not sufficiently close or disciplined in many industries to enable the responsible body representing those industries to go to the Defence Departments and arrange a definite programme of production so ordered as to provide for both service and civilian needs, involving prices and periodic review of productive progress in connection with changing requirements such as war imposes. But this is surely the only way in which our national resources can be rapidly directed and adjusted to national needs. The sort of thing I mean is this. In the Iron and Steel industry we are on the whole more closely organised and self-disciplined than many industries. But we have had more time to do it in and we have been a long time doing it. Thus, when the transition from peace to war came we were able to slide into it.

Let us look at the background. There is the question of the supply of raw materials, particularly those imported. In our case the continuity of supply of imported materials is absolutely essential to the maintenance of maximum production. There have been difficulties about shipping, freight and insurance, and difficulties about the price at which the raw materials can be landed in this country. If the price runs up abnormally because of freight insurance and increases in neutral countries from which we purchase, we still have to try to keep the price of our ultimate product as low as possible. Otherwise you have the old trouble of the ascending price spiral, resulting from the rising cost of living and consequent rising wage level, and you end up with an almost impossible position which can only be adjusted when Peace is established by a catastrophic slump, and unemployment problem. In the Iron and Steel industry we have endeavoured to mitigate that by spreading the increased cost of raw materials which have to be imported over the whole industry, thus reducing the price of the ultimate product to the minimum which is possible without incurring heavy loss. Other industries will bear in mind the need to keep the lowest price level possible by means of close co-operation within themselves, which means close enough to settle price policy on a national basis and to deal with the question of supplies co-operatively. They must be able to state definitely as an industrial unit what their requirements are for national needs so that their suppliers also similarly organised may be able to budget months ahead to meet those requirements. Of course production programmes are subject to sudden changes and demands, but so long as the industries which are consuming those materials, or are supplying them to others, are organised enough to get together the whole industrial structure of the nation will be able to adjust itself much more easily to changes of that kind than if we try to do it as the need presses upon us as individuals. The thesis I want to submit with regard to this particular aspect is this. Industry has the choice now whether it shall be self-governed or whether it shall be Government-controlled, and I beg you to elect for self-government. Self-government is certainly the duty of industry and it should be the business of the State to create such conditions as ensure that efficient self-government of industry is possible. We need efficient self-government in all sections of our industry. Take this great Association of yours. I know you have a very large number of groups dealing with every section of the engineering industry. If each section which might be considered a productive unit had within itself an organisation to deal with problems of supply, prices, or reservation of labour, &c., as a unit, and it was then represented on the Council of this Association where the broad policy of the Engineering industry would be formulated, and conflicting and interdependent interests reconciled and safeguarded, I venture to think the already magnificent contributions of the Engineering industry to our national effort would be substantially strengthened.

My own view is that the industrialists in this country do not exercise anything like the influence on national policy that their position of responsibility in relation to the community should impose upon them. If that is so, we must first establish a sense of responsibility in this matter on our own part. Take the question much before the public and ourselves in which your immediate Past-President, Lord Dudley Gordon, is so interested, the export trade. There should be no two opinions about it. Everyone agrees in normal times that we must export to live and that the export trade is vital. But the trouble is that people will talk now as though it were a case of Exports or No Exports. The truth as I see it is that export trade must be maintained at the highest possible level at which it can make a vital contribution to the Allies cause. That is our first aim and that is the only condition under which we must consider export trade. The export markets of the world are open to anyone who can take them, at present. It is not a question of developing markets or competing with other countries at the present time. As was said by Mr. Amery and others in the debate on December 7th in the House of Commons, the export trade should be considered intelligently in relation to our military effort. If you ask whether it is wise to export copper at the same time that the whole of our copper is imported the answer is Yes, *under the appropriate conditions;* of course you export it in the proportion in which it enters into the manufacture of those classes of highly manufactured exports which cannot be made without it, such as your own products. You should be prepared to import such quantities of materials as may be necessary to make the goods, the sale of which in export markets provides the greatest value of foreign exchange for the industrial effort involved to pay for our essential imports without which we cannot wage the war at all. In this sense it is obvious exports make a vital contribution to our war potential. We must secure that a reasonable appreciation of industry's relationship to the national effort is accepted in all quarters. If we can secure complete collaboration between industry and the Departments of State, we ensure that prompt response to demands which the Totalitarian State can impose; without the probability of such mistakes involving dislocation and ultimate disaster as dictation without full knowledge must ultimately produce. If we succeed in achieving this degree of organisation in the war period, as we must, let us be sure to continue to develop it in the immediate post-war period. There was no greater tragedy to my mind than the failure of industry in 1919 to continue the comparatively small, but in the end effective, degree of organisation which war conditions had imposed upon it. There was in so many minds such relief at the ending of Government control that industrialists were thrilled with delight at being able to go their own way. Instead of taking the gift of the export markets of the world, which were open to us as our European competitors were out of business pending the rebuilding of their industries, we not only did not go for them but actually restricted our exports at that time. It would probably have been better to have gone short in our own country for a time in order that we might have re-established our markets and thus have done something to mitigate, if not prevent, the catastrophic slump from which we suffered from 1919 to 1931. You may say that is wisdom after the event, but I felt it badly at the time, though I had a deep sympathy with my friends who had suffered restriction under control. But we must not do that again. I do not mean that we must not get our individual freedom. I mean that in the exercise of our freedom we should continue to develop and strengthen our industrial organisations to the enormous advantage of industry, and to promote collaboration and not competition between ourselves in such matters as price control, research, standardisation, and the development of the export markets, &c. Let us when this war is ended be in a position to take up that policy of "might have been" with which Lord Dudley Gordon and I were associated in March last in Dusseldorf. That was torpedoed by the German invasion of Czecho-Slovakia, but if anyone cares to read the joint note issued as a result of those conferences he will find that it provides no bad charter or programme for the reconstruction period which must follow this war. In the new reconstruction period we ought to have such co-operation [within the whole industrial structure] with the State that we can mitigate both in degree and time any slump likely to arise in the post-war period. I fully appreciate that a country which imports so large a proportion of its foodstuffs and raw materials as we do must have difficulties in regulating the price level, but there are degrees of regulation. We need not allow artificial price booms to arise in our own products within our own country. They need not happen if we have intelligent collaboration between interdependent industries, if we who supply your raw materials collaborate with you, and you in turn collaborate with your consumers for the maintenance of the price level. I would like to see it carried still further internationally; obviously if it were possible to establish a policy of a controlled price level between the primary producers we could ensure at least a measure of continuing, if not progressive, prosperity. The technique of such co-operation has already been developed and applied in several industries. I understand there are no less than forty International agreements regulating competition in export markets to which British Industries are already parties.

The conflict in which we are at present engaged imposes upon the individual complete subordination of the personal to the national interest; as in war this is not only the duty but in the highest interest of the individual, so I believe in peace the same is true. Collective prosperity is essential to the well being of the individual. None can prosper in a bankrupt world. Economic reconstruction will thus be most rapidly achieved by the maximum of co-operation between interdependent industries, Nationally and Internationally.

* B.E.A. Luncheon Address by Sir William Larke, Dec. 14th, 1939.

SCIENTIFIC WORKERS FOR THE FORCES.—It is announced by the Ministry of Labour and National Service that men at or above the age of reservation in scientific occupations may volunteer in approved cases for service in the Forces.

Rail and Road

AMERICAN ROAD VEHICLE PRODUCTION.—It is estimated that the production of road vehicles during 1939 in the United States and Canada will total 3,720,000. During the first eleven months of the year 2,449,423 motor cars and 478,625 commercial vehicles were sold.

MANY SPECIAL TRAINS.—The Railway Executive Committee has announced that between December 18th and January 1st last, 2801 special trains were run, a daily average of 153. Of these 1810 were passenger trains, and 491 freight trains. The heaviest days were December 21st and 28th, when 299 and 305 special trains respectively were run.

NEW VEHICLE REGISTRATIONS.—A report by the Ministry of Transport states that the number of mechanically-propelled road vehicles registered for the first time in Great Britain during the month of November 1939 was 10,070 compared with 33,833 in November 1938. Of the 3549 private types of motor cars registered, 2477 did not exceed 10 H.P.

RAILWAY COLLISION AT WARE.—On the evening of Monday, January 8th, the 4.30 p.m. train from Liverpool Street collided head on with the 5.24 p.m. train from Hertford East to London, near Ware. Six persons were injured sufficiently to go to the hospital where only one of them was detained. Single line working was in operation at the time of the accident.

THE GREAT WESTERN RAILWAY.—In explaining the cause of the delays sometimes caused to passenger trains, the Great Western Railway Company recently pointed out that since the outbreak of war it had run over 2500 special trains for the fighting forces, their stores and equipment. During the four weeks ended November 11th, the freight engine mileage of the company totalled over 4,404,000.

RAILWAY ELECTRIFICATION IN SOUTH AFRICA.—The electrification programme of the South African Railways has now been practically completed and work is in hand on the final 23 route miles between Rossburgh and Hillcrest. When the scheme is completed, there will be 605 route and 1232 track miles under electric traction. On the Witwatersrand suburban services only the section between Canada and Villiage Main has yet to be energised, and this is now being converted.

STEEL PILE BRIDGE PIERS.—In the construction of some of its bridges, the Canadian National Railways has adopted a method of using long H-section steel piles for both the foundations and the piers. A typical pier of this kind consists of H-section piles covering the entire area in evenly spaced rows. The tops of the piles are welded to steel channels which form the bearing cap. Between the water level and the pile tops the piers are braced by welding on steel angles. The tops of the piles are held in position by temporary jigs while the caps and bracing are being welded.

RUBBER AND RAILWAYS.—The British Rubber Publicity Association has just issued a second and revised edition of its book "Rubber and Railways," by Mr. C. Macbeth. It deals with the utilisation of rubber in rolling stock as exemplified in British, American, and European practice. Sections are devoted to rubber draw bar and buffer gear, auxiliary bearing springs, coach work, and the application of pneumatic tyres to railway wheels. All the information is supplemented with illustrations and drawings. Those interested in the subject may obtain copies of the book, free of charge, upon application to the Secretary of the Association at 1, Albert Mansions, Lansdown Road, Croydon, Surrey.

MOUNTAIN RAILWAY ELECTRIFICATION IN SWITZERLAND.—The rack railway between Glion and Rochers de Naye, near Montreux in Switzerland, was put into operation in 1892. It is nearly five miles long and climbs about 4200ft. and, until it was electrified recently, was steam operated. According to the *Electrical Review* its five electric coaches are mounted on two twin axle bogies, each bogie being equipped with a D.C. series motor developing 77 kW at 2080 r.p.m., which corresponds to a speed of the trains on the rack of 7·7 m.p.h. The power for the line is supplied from the 32-kV system of the Société des Entreprises Electriques Fribourgeoises, and is stepped down to 8200 volt at an automatic sub-station about 2¼ miles from Glion, remotely controlled from the railway station at Caux. The plant at the sub-station comprises two 8200/800-volt transformers and two mercury rectifiers.

ROAD TRANSPORT IN BRITAIN.—According to the *Financial Times* a concern known as Traffic Movement has been registered as a company limited by guarantee without share capital to undertake the carriage of goods by road. The company, which will operate only for the war period and one year after, is a subsidiary of Associated Road Operators and will not, it is claimed, take away any trade from existing road hauliers. It aims to carry new traffic arising from the war. It is proposed to limit the activities of the company to the distribution of traffic secured from Government Departments and similar bodies, or from road operators having traffic in excess of their capacities. From the rate obtained a percentage deduction will be made. The profits, after deduction of all outgoings, will be distributed among members of the company in proportion to the daily tonnage they agree to carry for the company if called upon to do so.

LOCOMOTIVE CUT-OFF.—An American company has developed an instrument which shows a locomotive driver the correct cut-off for each variation in speed. Known as the "Loco Valve Pilot" it is actually a speedometer which functions in the usual way, but has on its dial a second pointer which indicates the correct cut-off. It is driven by a friction contact device on the tread of one of the driving wheels through a flexible shaft and a centrifugal governor which actuates the speed indicating needle. The cut-off device is based on the principle of converting the motion of the reverse shaft into cut-off. This is done by connecting the reverse shaft to a cam mechanism by a cam operating rod, the action being converted to cut-off in the cam box. From this a cable transmits movement to the cut-off hand on the instrument's dial. The apparatus includes a recording instrument which charts a record of the speed and cut-off throughout a run.

Miscellanea

RETIREMENT OF DR. C. H. DESCH.—Dr. C. H. Desch, retired from the post of Superintendent of the Department of Metallurgy and Metallurgical Chemistry, National Physical Laboratory, on December 31st, 1939, having attained the normal age limit. Dr. Desch will be succeeded by Mr. C. Sykes, of the Metropolitan Vickers Research Laboratories, who will take up his duties at Teddington on March 1st, 1940.

COST OF STEEL PRODUCTION.—According to statistics of the American Iron and Steel Institute, more than 171 million dollars were spent on the upkeep of plant and properties by the steel industry of the United States during 1938. Maintenance and repair charges during the year amounted to approximately 9·20 dollars per ton of finished steel products, and the cost of upkeep accounted for 9·2 per cent. of the industry's gross income from sales.

MINERAL PRODUCTION IN CANADA.—During 1939, Canadian coal production totalled 15,507,000 tons, valued at over 48 million dollars as compared with 14,295,000 tons in 1938, valued at nearly 44 million dollars. The output of nickel is officially estimated at 227·1 million pounds, and platinum metals production at 292,000 ounces. Over 7,740,000 barrels of crude petroleum were produced, and it is estimated that the total mineral production for the year will reach the record value of 470 million dollars.

NORTH WEST MIDLANDS ELECTRICITY DISTRICT ORDER.—The Minister of Labour and National Service gives notice that as soon as may be after February 15th he will designate to the North West Midlands Joint Electricity Authority the employees' organisations having members in the employment of authorised undertakers in the district, in order that the organisations so designated may choose a representative of persons employed in connection with the supply of electricity in the district to be a member of the Joint Authority.

THE LATE MAJOR W. H. DICK.—It is with much regret that we have to record the death, at Gosforth on January 9th, after a long illness, of Major W. H. Dick, for many years managing director of Wailes Dove Bitumastic, Ltd., Hebburn-on-Tyne. He was born in Newcastle in 1880, and educated at Marchbank School, and George Watson's College, Edinburgh. As a young man he joined the firm of Messrs. Holzapfel (now International Paint and Compositions Company), the founder of which was his brother-in-law. In 1911 he joined Wailes Dove Bitumastic, Ltd., as a director, ultimately taking over the entire management. During the Great War he served in the Royal Engineers, was made Staff Officer, and retired with the rank of Major.

ACETYLENE FUEL FOR INTERNAL COMBUSTION ENGINES.—Tests have been made in France on the use of acetylene as a fuel for internal combustion engines. The gas was produced by bringing water into contact with calcium carbide and the gas given off had a calorific value of 1518 B.Th.U. per cubic foot. A Fiat four-cylinder engine was employed, developing with petrol 16 H.P. at 2800 r.p.m. Tests proved that the engine could be run without danger if precautions were taken against back-fires. Ignition had to be retarded to suit the more rapid combustion of acetylene. Running conditions appeared normal, but the efficiency was improved, the relative consumptions of heat being 12,900 B.Th.U. per H.P. hour with acetylene and 17,860 with petrol.

COAL DUST SUPPRESSION BY WATER SPRAYS.—In a paper, reprinted in *Iron and Coal Trades Review*, before the Yorkshire Branch of the National Association of Colliery Managers, Mr. J. R. Shaw gave the results of experiments at Shaw Cross Colliery on the suppression of coal dust by means of water sprays. The results of the experiments are summarised as follows:—The spray enabled the dust from a conveyor to be kept down to 18·4 per cent. combustible; the spray did not wet the coal delivered or the surrounding strata; the spray only used 2 galls. of water per hour, and the consumption of compressed air was very moderate; the sprays did not block up and required little attention; salty water gave the best results, giving a better deposit and rendering the coat dust less explosive; in the author's opinion the coal dust which had passed through the spray was much less dispersible.

PRESIDENT OF THE F.B.I.—At a meeting of the Federation of British Industries Grand Council, held recently, Mr. Peter Bennett, from the chair, moved the nomination of Lord Dudley Gordon as President for the coming year. Lord Dudley Gordon, who is ex-President of the British Engineers' Association, has served for a number of years on the Grand Council, and was a few months ago appointed Deputy-President of the Federation. He is the second son of the first Marquess of Aberdeen, a one-time Governor-General of Canada, is chairman of J. and E. Hall, Ltd., of Dartford, and represents the engineering industry on the Advisory Council of the Board of Trade. After leaving Harrow, he began his working life as an apprentice at Hall, Russell and Company's shipbuilding yard at Aberdeen, and afterwards went to W. H. Allen, Son and Co., Ltd., at Bedford. During the Great War he served in the 9th Gordon Highlanders, becoming Colonel of the Battalion and receiving the D.S.O. in 1917.

TELLURIUM.—In a report on the Canadian mineral industry in 1938, it is pointed out that metallic tellurium, until quite recently, was used very little in industry; formerly it was used to a very small extent in some radio work. Recent industrial research has shown that tellurium greatly increases the hardness, toughness, tensile strength, and corrosion resistance of lead, but the amount of tellurium so required is so small that about 65 tons of it would treat all the lead used in the United States for chemical plants and for general building construction. The United States Bureau of Mines advises, however, that the market for tellurium in that country could be more than doubled should tellurium lead come into general use for lead cable coverings. Tellurium, like selenium, imparts free-cutting properties to alloy and plain carbon steels. In the very finely powdered form it is used in the compounding of rubber, in which case it shortens the time of curing, and greatly improves the resisting qualities of the product. These latter two uses have increased the commercial demand for the metal.

Air and Water

BERLIN-MOSCOW AIR SERVICE.—On Friday, January 12th, a passenger machine of the Lufthansa left Berlin on the first trial flight of a proposed Berlin-Moscow air service. It is expected to open a regular service at the end of the month.

NEW AMERICAN AIR LINERS.—American Air Lines have ordered fifteen new Douglas four-engined air liners capable of a top speed of 268 m.p.h., and having sleeping room for 22 passengers. They are to be used for one and two stop flights across the United States.

NEW AMERICAN SHIPS.—The United States Maritime Commission announces that tenders are shortly to be invited for the construction of two 35,000-ton liners, which could be rapidly and easily converted into aircraft carriers, each with accommodation for 75 aeroplanes.

SHIPPING CASUALTIES.—It is announced that during the week ended January 6th, two British ships totalling 5758 tons, and three neutral ships of 5385 tons were sunk owing to enemy action. Since the war began only twelve of the 5911 British, Allied, and neutral ships convoyed have been sunk.

PURCHASE OF AMERICAN SHIPS.—Subject to approval by the United States Maritime Commission, six American cargo ships are to be purchased by the British Ministry of Shipping. The Commission has approved the sale of eight ships to a Norwegian company. Seven of the latter ships are of about 7430 tons gross register, and one of 13,869 tons.

AIR TRAVEL SAFETY.—A supplement to the report on the progress of civil aviation in 1938 shows that during 1938 approximately 4,697,000 passenger miles were flown by British civil aircraft for each passenger killed. The aircraft miles flown per fatal accident numbered 3,583,000. During the year, 56,368,000 passenger miles were flown and 222,200 passengers carried, there being four fatal accidents in which 12 passengers and eight of crews were killed, and four passengers and one of crews seriously injured.

BRITISH CONTRABAND CONTROL.—During the week ending January 6th the British contraband control intercepted and detained 6200 tons of contraband goods of which there was evidence that they were destined for Germany. This total included: 2400 tons of petroleum and allied products, 1000 tons of pig lead, and 100 tons of various ores and metals. The contraband control has, in the first 18 weeks of war detained a total of 544,000 tons of goods. On January 9th there were forty-eight neutral ships in the three contraband control bases in the United Kingdom, of which twenty-four had been there for five days or less.

THE WORK OF THE FRENCH NAVY.—In a recent statement to the Press, the French Minister of Marine, M. Campinchi, said that the French Navy alone had sunk 10 enemy submarines, examined 239 vessels, and intercepted 622,000 tons of merchandise bound for Germany. Of the 750 vessels convoyed only one had been lost to date. French shipping losses amounted to 11 ships aggregating 55,770 tons, or only 2 per cent. of the fleet in September last. He pointed out that allied shipping losses amounted to 137,080 tons in September, 117,170 tons in October, 24,759 tons in November, and 33,700 tons in December. The monthly average loss from all causes was 84,000 tons as compared with 309,000 tons in 1917–18. He disclosed that 126 warships are at present under construction in French shipyards.

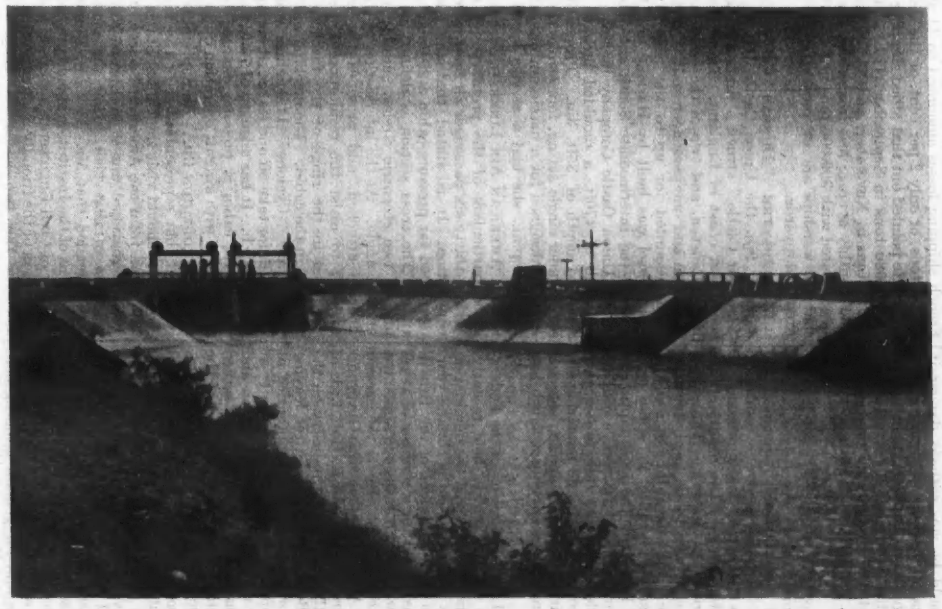
LOSS OF THE "DUNBAR CASTLE."—On Tuesday, January 9th, the Union Castle 10,000 ton motor liner "Dunbar Castle" struck a mine and foundered off the south-east coast of England. The commander, Captain H. A. Causton, and two of the crew were killed by the explosion and one passenger and six of the crew had not been accounted for up to the time of going to press. This vessel was built by Harland and Wolff, Ltd., and entered the intermediate South and East Africa service of the Union Castle Company in May, 1930. She had a length of 470ft., a moulded breadth of 61ft., and a moulded depth of 35ft. 3in. Propelled by twin screw six-cylinder single acting, four stroke pressure charged oil engines, designed for a maximum output of 6300 S.H.P. at 105 r.p.m., she had a service speed of 14½ knots.

NEW AMERICAN AIR LINER.—A recent issue of *Flight* gives particulars of the prototype of the new Curtiss Wright thirty-six passenger air liner which is now nearing completion. It is stated that the fuselage design is developed for pressure-cabin and freight-space considerations. The cross section is defined by the intersecting arcs of two eccentric circles, suitably faired at the re-entrant angle. At the intersection of the two circles the floor is attached, and provides the necessary tension member to resist the resultants of the tensile stresses produced in the rings of the fuselage by the internal pressure in the cabin. The machine will have two Wright double row "Cyclone" 14 engines which are rated at 1600 H.P. for take off and its maximum speed is estimated at 243 m.p.h. It has a length of 75ft., its wing span being 108ft. Its cabin is pressure charged to give a 6000ft. atmosphere with aircraft operation up to 20,000ft.

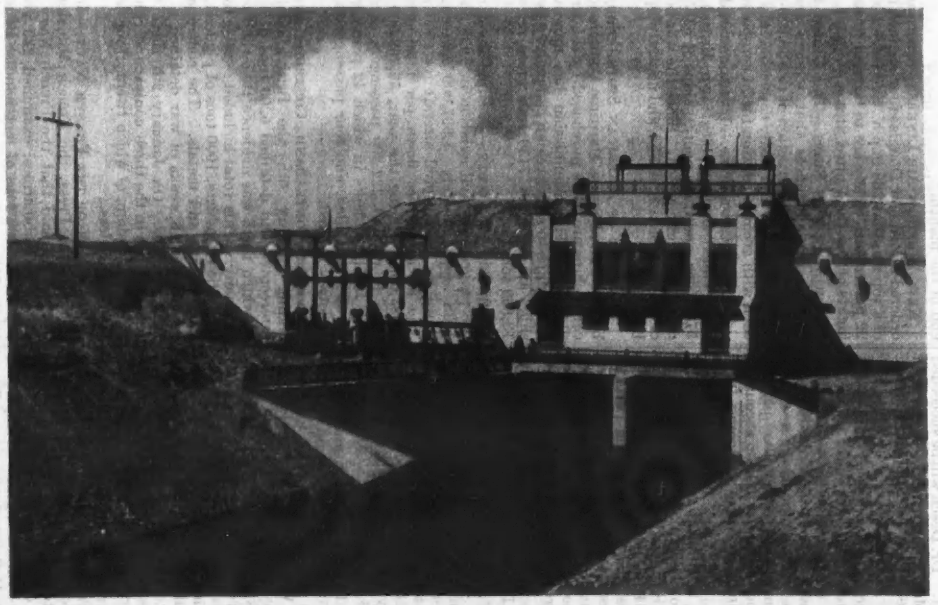
THE MYDDELTON CUP.—In September last it had been arranged that representatives of the Institution of Civil Engineers should visit the United States in response to an invitation from the American Society of Civil Engineers, but international unrest in Europe resulted in the cancellation of that visit. Had the visit taken place, it was intended that Mr. W. J. E. Binnie, who was then President of the Institution should present to the American Society of Civil Engineers a replica of the Myddelton Cup, as a token of the friendly relations which have ever existed between the two societies. Lord Lothian has now, however, on behalf of the Institution, handed the replica to Colonel D. H. Sawyer, President of the American Society, at a gathering of the members of that society held in Washington on Tuesday, January 9th. The original cup was presented to Sir Hugh Myddelton in 1613 by the Worshipful Company of Goldsmiths of London for his services in providing London with a supply of potable water. It remained in the possession of the Myddelton family until 1922, when it was acquired by the Goldsmiths' Company.

SALINILLAS HYDRO-ELECTRIC PLANT AND MADERO DAM, MEXICO

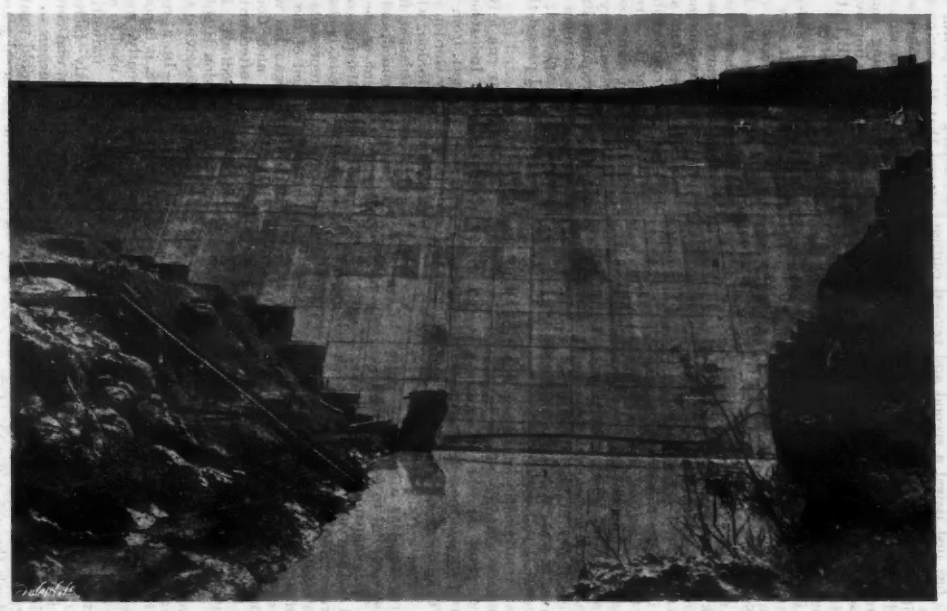
(*For description see page 54*)



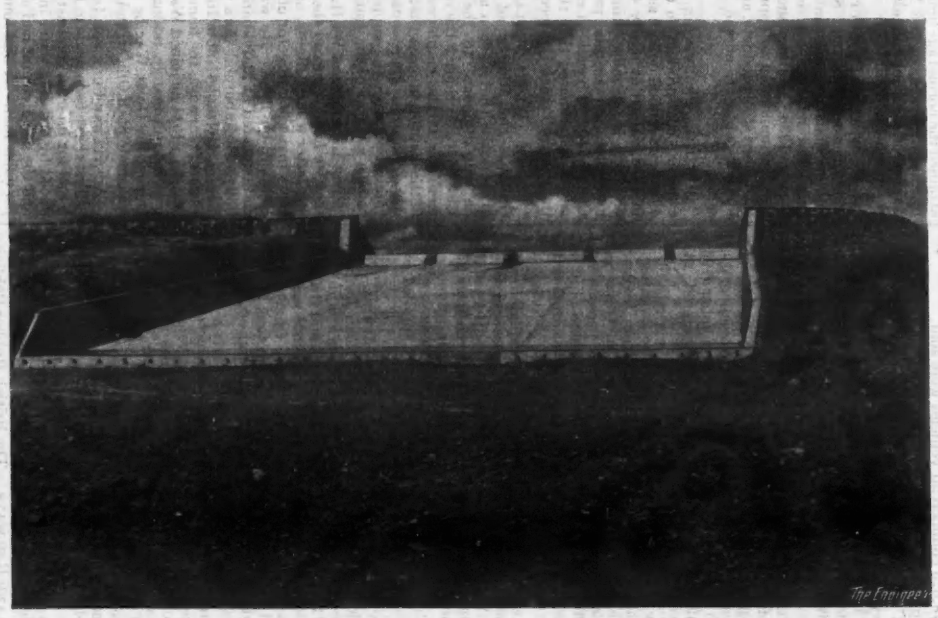
HEAD GATES, SALINILLAS HYDRO-ELECTRIC PLANT



POWER HOUSE AND SUB-STATION, SALINILLAS HYDRO-ELECTRIC PLANT



REINFORCED CONCRETE SLABS, UPSTREAM FACE OF MADERO DAM



SPILLWAY AND APRON, MADERO DAM

The Engineer

JANUARY 19, 1940

VOL. CLXIX No. 4384

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ALTERNATIVE FUELS IN AIRCRAFT

To combine high thermal efficiency with the maximum of convenience in use, both essential in aircraft fuel, is no simple matter. Were thermal efficiency the sole desideratum, hydrogen would be the ideal fuel; on the other hand, if convenience were all one had to seek, what could be better than the ordinary fuel of the motor car? But hydrogen, whether in its elemental state or combined in such a gas as methane, requires high pressure steel containers of which the weight and bulk are severe drawbacks. Hence, although this alternative is not impossible, it is unattractive under the conditions usually prevailing, though of course the pressure of war conditions might at any time cause the balance of advantage and disadvantage to be struck anew—struck differently. In the high speed internal combustion engine the fuel is nearly always in liquid form, although persistent efforts have been made to use powdered coal instead. But for aircraft engines where continuous, unflagging, uninterrupted running is vital to the life of the craft, any fuel containing solid particles which might get jammed in some part of the mechanism is unacceptable. For normal aircraft usage, preference will always be given to a liquid fuel; it does not clog as does a solid, and it does not dissipate itself as does a gas. To-day a wide choice is possible amongst the almost innumerable types and blends of liquid hydro-carbons, many of which do succeed in combining in degree the essential qualities of high thermal efficiency and practical convenience.

For good thermal efficiency, the engine requires a high compression ratio and an even distribution of fuel to all the cylinders; but there must be entire freedom from detonation. Many modern aviation fuels give this freedom in quite remarkable degree, for in this field the ingenuity of the industrial chemist seems almost boundless, and some day a wonderful tale will be told of it. (But so far he has not produced the safety fuel with high octane value of which American predictions have been made.) For aircraft use, fuel of 100 octane value is becoming fairly common, and a degree of power output and of fuel economy hitherto unknown is now possible. But it is an expensive fuel and of course it readily takes fire on crash. A less volatile fuel would be preferred for many reasons; it would be safer and would cost less. But if sufficiently low in volatility to make it safe it is likely to be a poor medium for a carburettor to work on, and some method of forced injection is the necessary alternative. Much work has been done in this direction in America where "petrol injection" schemes were very widely talked of and were greatly in favour a few years ago, and especially in Germany to-day where the pressure to make use of low grades of petrol is acute. From the sole point of view of mechanism, preference would naturally be given to the carburettor, and this method still holds the field despite its serious drawback in liability to ice formation in unfavourable weather conditions, though it is known that this can be guarded against by heating the metal parts at the cost of some increase of complexity. Even with injection systems the engines are normally fitted with electric ignition, though it is of course possible to apply the compression ignition principle, and dispense with the complication of the electric ignition apparatus so much disliked, for good reason, by the engineers in charge of the aircraft radio circuits. Excellent work has been done in this direction, and compression ignition engines have for years been available for use either on military or civil aircraft. For the latter they are especially attractive because of the low fire risk and the low fuel cost. But they have been comparatively little used. The reason is that aircraft are being pushed to give higher and yet higher standards of aerodynamic performance, even civil types, and it is quite impossible to give anything away on the power plant; experience has shown that the petrol engine, whatever the improvements made in the compression ignition engine, can always be counted on to go one better. If this is the case with the typical civil airliner, where the use of a real safety fuel would be such a gain, it can be imagined that in the case of military aircraft there is little room indeed for the engine having less than the highest performance. Military aircraft which are not equipped with engines of the highest efficiency must quickly fall victims to their rivals.

Hence for war planes the choice of fuel is not normally a wide one, though in the event of a failure of supplies it would be natural, indeed necessary, to make the most of what might chance still to be available, even at the inevitable price of some lowering of efficiency in operation. Some engineers have, however, doubted whether the use of compression ignition engines need have led to any such lowering of the economy ratio, and have urged that, even if this be so at the moment, it is a situation that could be remedied were sufficient efforts put into the endeavour. Advocates of this view urge that had money been spent as freely on the C.I. type as it has been on the petrol engine, the balance between the rivals would be very different. Most of this expenditure has no doubt come chiefly from military sources, but this would not favour one engine more than the other, since it is results that are looked for. It is inevitable, however, that when one type of engine gets even a little ahead in the race it should tend to keep the lead, as being the one most likely to be selected for favourable attention when research funds are next being allotted; but there is more in it than that. Compression ignition engines call for more assiduous maintenance and as the virtue of a large number of running hours between overhauls is one of the very highest from the service view, whether military or civil, they suffer in this comparison with their more carefree rivals, despite the safety and economy of the fuel they use.

The World and Its Trade

LONG before the war, many writers, ourselves amongst them, preached the doctrine that a principal step towards prolonged peace would be taken by the settlement of international economic problems. That doctrine gained in strength as the months passed. The principle of self-sufficiency began to totter and several international conferences were held with the object of arranging and adjusting trade conditions. Unfortunately, at the very time when there were sound reasons for hoping, even believing, that a new order was coming into existence, the Nazis elected to nip the new movement in the bud and to seek to set up by force of arms an autocracy over the greater part of the European continent. Instantly the many months of patient work of the economists and industrialists of several countries, and particularly of Great Britain and Germany herself, were thrown to the winds. France and this country girded on their armour, buried their dossiers, and blotted out for the time being the picture of a more settled world which they had contemplated. Then came the war, and before four months of it had gone by we saw with satisfaction that instead of arresting the movement towards better international understanding on economic questions it had in fact accelerated it.

A few weeks ago Sir John Simon explained to the House of Commons the terms of an Anglo-French agreement in which may be seen the beginnings of a new era in trade relationships between nations. For whilst it is true that the terms of the agreement were drawn up to meet war conditions there are in them elements that may assume permanence and, remaining after the war is over, pave the way for a better and larger economic entente. The Anglo-French agreement has been welcomed unreservedly in this country and foreshadowings of its extension are already visible. "Talks" are taking place with Holland, Belgium, Italy, Spain and Denmark, and an agreement has already been reached with Turkey. Others will follow. The fact is that the whole industrial and economic world is beginning to long for something better than the constant international rivalry which grew up after the Four Years' War. Instead of continuing to slam the door in each other's faces, industrialists are beginning to crack it open a little bit and make tentative addresses to each other. It is now recognised, as Sir William Larke said in an address which we reprint on another page, that "Collective prosperity is essential

to the well being of the individual. None can prosper in a bankrupt world. . . . Economic reconstruction will thus be most rapidly achieved by the maximum of co-operation between interdependent industries, Nationally and Internationally." This sentence was the culmination of an argument in which Sir William had urged industrialists to organise themselves more fully so that they might be in a position to exercise greater influence on national policy. The trade with which he is associated—Iron and Steel—is amongst the most highly organised, and it has arranged national agreements of the first importance with foreign countries. What he desires to see is the adoption of organisation of that kind by other industries and trades. The foundations already exist. We have not only such bodies as the B.E.A., which Sir William was addressing, but the F.B.I. and the B.E.A.M.A., and it is said that in our industries as a whole there are no less than five hundred organisations for price control and allied considerations. Thus there are in existence already nuclei around which international agreements might crystallise.

There was a time, not so long ago, when nations sought industrial supremacy, Great Britain enjoyed that position for years but saw it leave her as one after another nation, often taught by her and furnished with material by her, challenged it. Then came the war of 1914–18, and after it the era of national self-sufficiency. The hollowness of that policy has become evident, as it was bound to do. There is no industrial people in the world that does not now admit the need of international trade. Before the present war opened, the first little steps towards a better understanding had been taken. Possibly it was because the leaders of Germany foresaw that the universal extension of such an understanding would put a limit to their will for supremacy that war was launched. But

"There is some soul of goodness in things evil,
"Would men observingly distil it out,"

and it may be that the great trial through which the world is passing will accelerate the movement which Germany sought to arrest, and that when peace comes back once more all the nations of the world will be in a temper to accommodate their differences and to seek for means which will enable all to live and progress, with no more rivalry than that which leads to greater excellence and greater benefit for all. No doubt generations will live and die before man comes to regard all the industrial parts of the world as but units in an amalgamation of all the nations of the earth for commercial exchange, but the beginnings of that great conception may spring from the evil in which we are all now involved.

Obituary

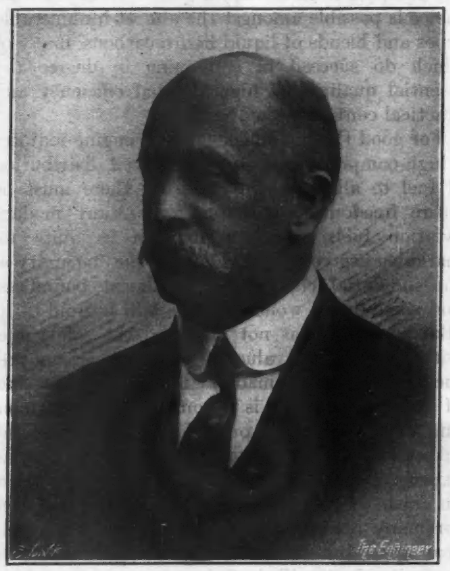
SUMMERS HUNTER

By the death of Summers Hunter, which occurred at the age of 84, on Sunday, January 7th, at his home, Darien, Stocksfield, Northumberland, Great Britain has lost an outstanding marine engineer, who was known not only in Tyneside circles, where most of his life was spent, but in all parts of Great Britain and the Continent.

He came from Scotland, and was born in Inverness in 1856. His early education was received in Scotland, but he started work at the early age of 14, and was apprenticed to a Staffordshire firm of name Barker and Cope, which at that time had extensive works at Kidsgrove in North Staffordshire. His technical studies were completed at the science classes which were held at the Wedgwood Institute in Burslem. During his early days he was fortunate in meeting and working for well-known men of his time who had an unforgettable influence on his character, and led his steps in the right path. Among these were Mr. George Elliott, Mr. George Bidder, better known perhaps as the "Calculating Boy," and also Mr. S. Bidder, all of whom were successful civil engineers.

Before his training was completed young Hunter was placed in charge of various important contracts, which he carried through on behalf of Messrs. Barker and Cope, and thereby gained valuable experience in the different branches of engineering which at that time were associated with the industries of North Staffordshire. It was about 1880, at the age of 24, that he decided he must take up marine engineering as his vocation, and to that end he joined the North Eastern Marine Engineering Co., Ltd., and entered the Sunderland Works. After serving in the shops for some time he went to sea and obtained his Chief Engineer's Certificate. During his time he suffered shipwreck, which imprinted on his mind a full appreciation of the dangers and responsibilities which are inseparably associated with the duties of a marine engineer. When the new Wallsend works of the company were built he was appointed to the technical staff, and in 1895 was made the general manager of the company. In 1899, he was elected to a seat on the Board, and in the following year was appointed managing director. Twenty years later he became chairman, a position he continued to hold until he retired in 1929, after serving the company for 49 years.

Summers Hunter was associated with several advances in marine engineering; one was superheating, which was introduced in order to achieve a greater economy with reciprocating steam engines. The North Eastern Marine Engineering Company took up the "Schmidt" system of smoke-tube superheaters, and developed it successfully. With the advent of the oil engine, the company became associated with the Werkspoor Company, of Amsterdam, and North-Eastern-Werkspoor engines



SUMMERS HUNTER

have been fitted in many successful motor ships. The main business of the firm was, however, steam engines and boilers, and during the time Mr. Summers Hunter was with the firm a considerable advance in the design and performance of marine steam engines was recorded, especially after the introduction of increased superheat and reheating. With the coming of the oil engine, considerable study was given by the firm to the problems connected with the production of special cast irons for marine engines, and for some time Mr. Summers Hunter was vice-president of the British Cast Iron Research Association. He was a strong advocate of advanced methods in workshop practice, and with the introduction of electric power on the Tyne was among the first to use that power for driving machinery and cranes. The Wallsend works of the company were electrified in 1900, and the following year electric power was installed in the Sunderland works, the company being for a long time one of the largest consumers of electric power on the Tyne.

He was keenly interested in young engineers, and many of the men who now occupy responsible positions in the firm were apprenticed to it, and served under Mr. Summers Hunter in the shops. The improvement of the conditions in the engineering branch of the Royal Navy was also one of his keen interests. During the last war Summers Hunter was an active member of many Government Committees, and his service to the industry and the nation was recognised in 1918 when he was made a Commander of the Order of the British Empire. He held for some years the position of chairman of the Standing Committee of the North East Coast Engineering Employer's Association, and was for some years a member of the Council of Armstrong College, Newcastle-upon-Tyne, and showed great interest in the engineering and naval architecture courses of the College. During his whole career Summers Hunter took the keenest interest in the work of the scientific institutions and technical associations, and from 1908 to 1910 he was President of the North East Coast Institution of Engineers and Shipbuilders. It was during his term of office that the Institution moved from its old premises in St. Nicholas Buildings to its present home in Bolbec Hall. In 1932 the Institution conferred upon him its Honorary Fellowship, in recognition of his pioneer work in the training, education, and welfare of apprentices and his personal interest in the progress of the work of the Institution. He was also President of the Institute of Marine Engineers for 1912–1913, and a member of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, of which he was a Vice-President, the Institute of Metals, and the Royal Society of Arts.

Alongside the work of his own firm he found time to interest himself in some other businesses, and was for some years a director of the Iron Trades Employers' Insurance Association, the Hydrogen, Oxygen, and Plant Company, Liquid Oxygen Explosives, Ltd., and the Tyneside Tramways and Tramroads Company.

Summers Hunter will be remembered by his unswerving integrity, and his technical skill and sound practical judgment which brought its own reward in a successful and useful career.

BASIL HUMBERT JOY

THE death of Basil Joy, which took place at his home at Quayside, Burnham-on-Crouch, Essex, in his sixty-eighth year, is for us a personal loss since, for several years, he was connected with our editorial staff. That loss will be shared by his many friends in the automobile industry and its marine side, for he was associated for close upon a quarter of a century with the Institution of Automobile engineers, and was largely responsible for its growth from small beginnings to the important position it now holds among British scientific societies and institutions.

Basil Humbert Joy was born in 1871 at Saltburn, Yorkshire, and received his education at Aldenham School. He served his pupilage in the office of his father, the late David Joy, inventor of the valve gear which bears his name, and after two years entered the Albert Dock Engine Works, in order to obtain shop experience. From that position he went on to the Chiswick Works of John I. Thornycroft, Ltd., for drawing-office experience. On the completion of his training he returned to his father's office and became a partner in the firm. While at the office he was appointed, through the instrumentality of Mr. F. R. Simms, an assistant to Claud Johnson for the Motor Car Trials which took place at Richmond in 1899. In the following year he was chosen to assist Mr. Claud Johnson in the Thousand Miles Trial around England, and in the Scottish Trials. He was then appointed manager of the Simms Manufacturing Company, and took part as a competitor in the Crystal Palace Trials. About that time he was made Technical Secretary of the Automobile Club of Great Britain and Ireland, as the Royal Automobile Club was then known. He organised the Motor Car and Motor Cycle Trials of 1903, the first Side-slip Trials, and the first Motor Boat trials which were ever carried out in this country. It is recorded that the material for the Side-slip trials was produced as the result of midnight experiments which were carried out in the Down Street garage of the Club.

Always a lover of the sea, it was with pleasure that Basil Joy accepted the position of manager at the Dartmouth launch-building yard of Simpson, Strickland and Co., Ltd., in 1905, but he was unable to stay at Dartmouth very long on account of his health, and returned to London in 1910. In that year he was appointed part-time secretary of the Institution of Automobile Engineers, and the rest of his time he devoted to THE ENGINEER, writing articles on marine matters and the marine oil engine in particular, which was then being introduced. For close upon ten years he continued this work. In our early issues of January, 1911, he described the first motor ship, the "Vulcanus," built by the Netherland Shipbuilding Company, and engined by Werkspoor of Amsterdam. The late Mr. Kloos, the designer of the Werkspoor engine, used to tell how Basil Joy took an important part in the trials of the "Vulcanus." Many of his staff had not been to sea before, and when heavy weather was met with they retired from the engine room leaving Joy, a seasoned seaman,

to minister to the many joints and bearings with the oil can.

In 1920 he was made full-time secretary of the Institution of Automobile Engineers, a position which he held with distinction until he had to relinquish that post because of ill-health in March, 1934. On his retirement the President, Mr. C. R. F. Engelbach, paid a warm tribute on behalf of the Council to the work he had accomplished in over twenty-three years, during which he had guided the Institution from infancy to maturity.

He was for some years a member of the Institution of Mechanical Engineers, an honarary and life-member of the Royal Motor Yacht Club, and a member of the Royal Corinthian Yacht Club.

Joy owed his success to his untiring zeal and to the almost school-boy-like pleasure he felt in the work upon which he was engaged, particularly when, in Stevenson's phase, it was "fooling about with boats." This zeal was infectious and gave him a charm of manner and attractiveness which no one could resist. His achievement with the Institution of Automobile Engineers was attributable in a very great degree to his personality. He entered into the work with infectious buoyancy and under his leadership it maintained a youthfulness of spirit that was very becoming in that youngest of our Institutions. In his day there was no man better known in automobile circles and more loved than he.

JOSEPH EMERSON DOWSON

A FURTHER link with the early development of the gas engine and the use of producer gas, for power, industrial, and transport purposes has been broken by the death of Mr. Joseph Emerson Dowson, which occurred at his home, Landhurst Shaw, Hartfield, Sussex, on Wednesday, January 3rd, at the advanced age of 95. Joseph Emerson Dowson was born in London in 1844, and received his education at the Lycée de Versailles and Dulwich College. Originally it was intended that he should follow the legal profession, but he evinced a dislike for the law, and was trained as a civil engineer. He was articled to his father's firm of engineering contractors from 1863 to 1865, and in 1866 continued his pupilage as engineering contractor's assistant on works at Herne Bay, carried out by the late Charles Fox and J. W. Wilson, who were the engineers for the scheme. From 1866 until 1869 he was in sole charge of work carried out for the Scarborough Pier Company, under Mr. E. Birch, engineer. Further pupilage work was carried out with Mr. E. W. Hughes, and in that year he was passed by Mr. George Berkley as a second class engineer for the G.I.P. railway. In 1870 he was appointed engineer to the Redcar Pier Company, jointly with Mr. A. Dowson, and carried out work in conjunction with Head Wrightson and Co., Ltd. Two years later he went out to Ceylon and India, to report on projects for tramways in Colombo, Bombay, Calcutta, and Madras. Returning to England in 1873, he was appointed jointly with Mr. A. Dowson, engineer of the Cleethorpes Pier, and carried through extensions. In the following year he visited Saragossa to report on a project for water supply and drainage, and in 1875 visited Madras in connection with tramway projects. In 1876, he was engaged on various designs and reports, and on experimental work for Colonel Bolton and Mr. T. J. Bewick, among which was work on the treatment of low grade copper ores, and finding it necessary that he should understand the nature of the process he set himself to study inorganic chemistry, giving particular attention to the working of furnaces and the combustion of fuels. From 1876 until 1882 he continued to work on his own account. About 1878, he patented his invention for the making of a cheap gas for heating purposes, and for working gas engines, and collaborated in this work with the gas engine manufacturers. In 1879 the Dowson gas plant was put to work with a Crossley engine.

At the York meeting of the British Association of 1881 Mr. Dowson read a paper on the working of engines on suction gas, and illustrated it by a small Otto gas engine working with a Dowson producer plant. The engine and its plant were afterwards exhibited at the Smoke Abatement Exhibition, and Mr. Dowson was awarded a Gold Medal and prize, offered by the late Sir William Siemens for the best method for the utilisation of fuel as a heating agent for domestic and industrial purposes, combining the utmost economy, with freedom from smoke and noxious vapours. In 1882 he read another paper on gas producers before the Royal Society of Arts, and gained a Silver Medal. In 1901, he read a paper before the Institution of Civil Engineers on "The Efficient Working of Gas Plants for Engines," which gained for him the Watt Medal and a Telford Premium. For a further paper, read before the Institution of Electrical Engineers in 1904, he was awarded a Special Premium.

By this time engines up to 520 I.H.P. were successfully running on "Dowson" gas, and in order to develop this work he founded the Dowson Economic Gas and Power Co., Ltd, which in 1910 was merged with Mason's Gas Power Company, Ltd., to form the Dowson and Mason Gas Plant Company, Ltd., of Alma Works, Levenshulme, Manchester. This company was formed to develop the invention and carry on further research work. Research was especially necessary as the field was a new one, and many trials had to be made, there being no previous experience upon which to draw. As a pioneer company it was remarkably successful and installations of many kinds and sizes were established both at home and abroad.

Alongside his development work, Mr. Dowson found time to write the papers we have referred to, and was also the author, along with his assistant, Mr. A. T. Larter, of a standard book on producer gas which has run into many editions. Mr. Dowson was also the author of the article on "Gas Plants for Engines" in the Encyclopædia Britannica. For some years he was chairman of the Executive Committee of the Decimal Association and took an active part in advancing the adoption of metric weights and measures. He was a member of the Institution of Civil Engineers and of the Institution of Mechanical Engineers, and retired from active work about 1916, since when he had lived a quiet life in his country home.

Dowson was a remarkable man and was respected by everyone who knew him, not only for his engineering ability, but also for his unfailing courtesy. After retiring from the company, he made his home in the country, as already mentioned, but he retained a remarkably keen mind even at a mature age, and kept up his interest in his life's work, as is testified by correspondence carried on even at the age of 93.

SIR FRANCIS GOODENOUGH

A WIDE circle, both in commerce and industry, will hear with sincere regret of the death of Sir Francis Goodenough on Thursday, January 11th. Although particularly concerned with the gas industry he was a well known authority on education for commerce and industry, and in marketing problems. He was born at Newton Abbot, and following his education at the Torquay Public College, entered the service of the Gas, Light, and Coke Company in 1888, at the age of 16 years. He spent the entire 43 years of his business life in the service of this company and founded the gas sales department of which he became controller. Salesmanship was his greatest interest, and he once said that scientific marketing was of even greater importance than scientific production. He played a large part in the formation of the British Commercial Gas Association in 1911, and was from that date until his retirement in 1936 its executive chairman. When the Government appointed a Committee on Education for Salesmanship in 1928, he was chosen as chairman. In the course of his career he held, at one time or another, the offices of joint honorary secretary of the National Gas Federation, member of council of the British Gas Federation, member of council of the Federation of British Industries, president of the British Export Society, president of the Incorporated Sales Managers Association, a member of a departmental committee on examinations in part time schools, a member of the London Chamber of Commerce, chairman of the British Association for Commercial and Industrial Education, vice-president of the Institute of Export, and was an executive member of a large number of other bodies.

Literature

Bridge Calculation and Design (for Steel Bridges). By D. Y. Hill. London: Charles Griffin and Co., Ltd. 1939. Price 25s.

BRIDGE designers will find a "home from home" atmosphere about Mr. D. Y. Hill's very practical contribution to the literature of steel bridge calculation and design. In his preface, the author refers to the lack of text-books dealing with the theory of structures as applied to English practice, and he must have given considerable thought in order to compress into five short preliminary chapters the theoretical matter essential to his purpose. To look this up in a library of standard text-books, which are naturally compiled to accord with our existing educational and professional examination syllabuses, would mean referring to two or three different volumes.

Chapter I presents elementary notions of the resolution, combination, and equilibrium of forces, and conventional orderly methods of determining the centre of gravity and moment of inertia of a variety of sections occurring in bridge practice. The following chapter defines bending moments and shearing forces in beams and demonstrates the construction of corresponding diagrams for various conditions of support and loading. Force diagrams for several standard trusses provide exercises in graphic statics in Chapter III, and then the forces in an N truss, with curved top chord, are computed by the method of sections. The calculations are extended to illustrate the arrangement of live load which produces maximum web stresses, thus introducing the subject of influence lines applied to simple trusses and trusses with sub-panels.

In Chapter VI the author presents a moment table for reactions and bending moments, applied to the British Standard Loading for Railway Bridges, and states in the preface that as far as he is aware this has not been published before. Moment tables applied to Cooper's Loadings were published more than a quarter of a century ago, and a similar table applied to an actual British locomotive was published in THE ENGINEER about the same period. The author's moment table is used to determine stresses in two types of N truss. Curiously enough, it is not used to determine equivalent uniformly distributed loads from wheel loads; these are obtained by the old fashioned graphical method in the subsequent chapter. The elusive "x" has been omitted from Equation (1) in the chapter on the moment table, with the unfortunate result that a load is added to a bending moment. A chapter on working stresses, largely reproduced from the "British Standard Specification for Girder Bridges," completes the more theoretical portion of the work in rather less than half the total number of pages.

Of the four remaining chapters, the first relates to plate girder design. This is illustrated with typical sections and details of deck and through railway bridges, useful tables giving the maximum spacing of stiffeners for varying shear stress and thickness of web plate, abstracts from British Standard specifications with regard to rivet pitches, flange plate and angle splices and web plate splices, and the design of a small road bridge with longitudinal girders embedded in concrete for which calculations are reproduced. The chapter terminates with the complete design of a bridge girder of 75ft. span. The longest chapter of all, on truss bridge design, opens with the consideration of a number of practical points such as suitable sections for members, floor systems, laterals, sway bracing, portals, bearings, riveted joints, and camber, and terminates with the complete stress sheet for a sub-divided bridge truss. Then follow a short chapter in which the deflections of bridge trusses are determined by the method of least work and by means of Williot diagrams, and a final chapter on arches. The types considered are three-hinged spandrel braced and plate girder arches, and two-hinged spandrel braced and plate girder arches. The influence line method is used throughout, except in the case of dead load stresses in the three-hinged plate girder arch which are determined by the line of pressure method.

The 272 pages of text are illustrated with 290 figures, of which 22 are folding illustrations of stress sheets and detail drawings, and 14 very clear photogravures, which not only present examples of some of the best bridge practice, but also, among others, the work of the Cleveland Bridge and Engineering Company, Ltd., Messrs. Rendel, Palmer and Tritton, and the London County Council with whom the author served previously to taking up his present position as Assistant Bridge Engineer to the Kent County Council.

LIGHTHOUSE TENDER ACCIDENT.—As a result of an accident off the Eddystone Lighthouse on Thursday, January 11th, an officer and six men lost their lives. The Trinity House tender "Vestal" arrived off the lighthouse to deliver gear, and a motor boat put off from her to make contact with the lighthouse. Whilst ropes were being thrown to it by the keepers at the base of the lighthouse an unexpected sea broke over the boat and put the engine out of action. Following seas swamped the boat and she sank, only one member of her crew being saved.

New Producer Gas Plant

WE illustrate in the accompanying engravings a new producer gas plant, manufactured in this country by Gas Producers (Bellay), Ltd., of 66, Victoria Street, London, S.W.1. In the half-tone engravings a double-deck bus, with producer gas equipment mounted at the rear, is illustrated; this vehicle is one with which the Associated Equipment Company, Ltd., of Southall, in conjunction with the London Passenger Transport Board, has been conducting experiments, working in association with Gas Producers (Bellay), Ltd.

No structural alterations have been made to the body, as the equipment is mounted on a chassis extension. Although the converted vehicle does not comply with regulations governing overall length existing before the war, since it has a frame overhang of 18in., equipment mounted in this manner is claimed to have advantages over trailer-drawn plant, particularly considered in relation to negotiating bends and reversing.

FIG. 1—PRODUCER GAS PLANT CARRIED AT REAR OF DOUBLE-DECK BUS

The mounting of the equipment, which is compact and accessible, is clearly illustrated in Figs. 1 and 2. Normally the equipment is completely enclosed in a boot formed of sheet metal panels. It is assembled as a unit on a sub-frame, attached to the rear of the chassis frame. Only one pipe connects the producer and the engine and the equipment can therefore be mounted or removed quickly. The total weight of the equipment when loaded with fuel is about 8 cwt.

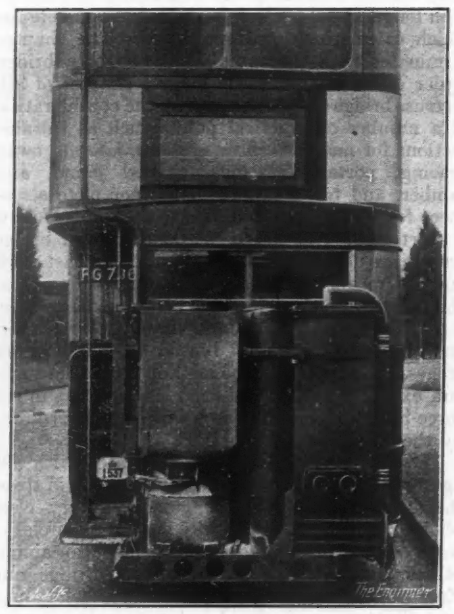


FIG. 2—ARRANGEMENT OF GAS PRODUCER EQUIPMENT

On the A.E.C. vehicle, when using producer gas plant, the existing induction manifold of the engine is employed, a gas-mixing valve being substituted for the carburettor, as shown in Fig. 3. This valve has been designed by the company, and is readily interchangeable for conversion purposes. Another type of valve, described in a later paragraph, is made by Gas Producers (Bellay), Ltd.

The Bellay gas producer is of the cross-draught pattern, and incorporates a water-cooled tuyere inserted at a downward angle in the generator. The arrangement is clearly shown in the drawings reproduced in Fig. 4. Through the tuyere the fuel recommended, anthracite, is ignited, and the gas produced is drawn by engine suction through a cooler and cooling system and a filter. The air flow is through the tuyere which changes in cross-section, until at the point of air entry into the fire zone it is in the form of a narrow slot, giving a flat wide stream of air, which passes through the fuel. The fuel descends automatically from a hopper, and there is created a centre of very high temperature, converting the CO_2 to CO. This temperature, amounting to about 1650 deg. Cent., is reduced to about 900 deg. Cent. near the gas exit, which is provided with a grill to prevent the passage of large particles of fuel. Parts surrounding these high-temperature zones are, of course, made of heat-resisting materials. Gas passes from the generator at the exit at the bottom of the unit to the cooling system and provision is made for a damper for use when shutting down the plant overnight or for other long periods. For water-cooling the tuyere, connection can be made either to the vehicle radiator or to a special radiator mounted on the generator as shown in the drawing. The fuel hopper is filled through a screw-down opening at the top, and is arranged to contain sufficient fuel for a journey of about 140 miles in the case of the bus unit, and for 230 miles on standard units.

In order to cool the gas and condense the water vapour contained therein, it is passed through a cooling system which can consist of one or more cylindrical expansion chambers, depending on the power of the engine and the arrangements permissible. In the arrangement illustrated the cooler takes the form of twin vertical expansion boxes mounted between the generator and filter units, in which by reason of the relatively slow flow of gas solid particles are precipitated and water vapour is condensed. For additional cooling a tubular unit with header tanks at each end is mounted below the filter unit. Each of the header tanks is provided with a quickly removable cover, so that the cooling pipes can be readily cleaned. It is desirable that the gas entering the filter should be at a temperature of not less than 70 deg. Cent., and the cooler is designed to give this temperature. Should, however, because of low atmospheric temperature conditions, or at the time of starting up the plant, the temperature at this point be below 70 deg. Cent., a by-pass can be opened between the generator and the filter, so that a portion of the gas passes directly to the filter. At the point of entry of the gas to the filter, a thermometer element, indicating in the driver's cab, is

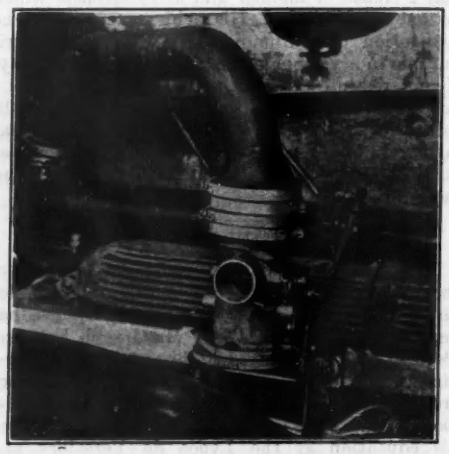


FIG. 3—GAS MIXING VALVE ON INDUCTION MANIFOLD

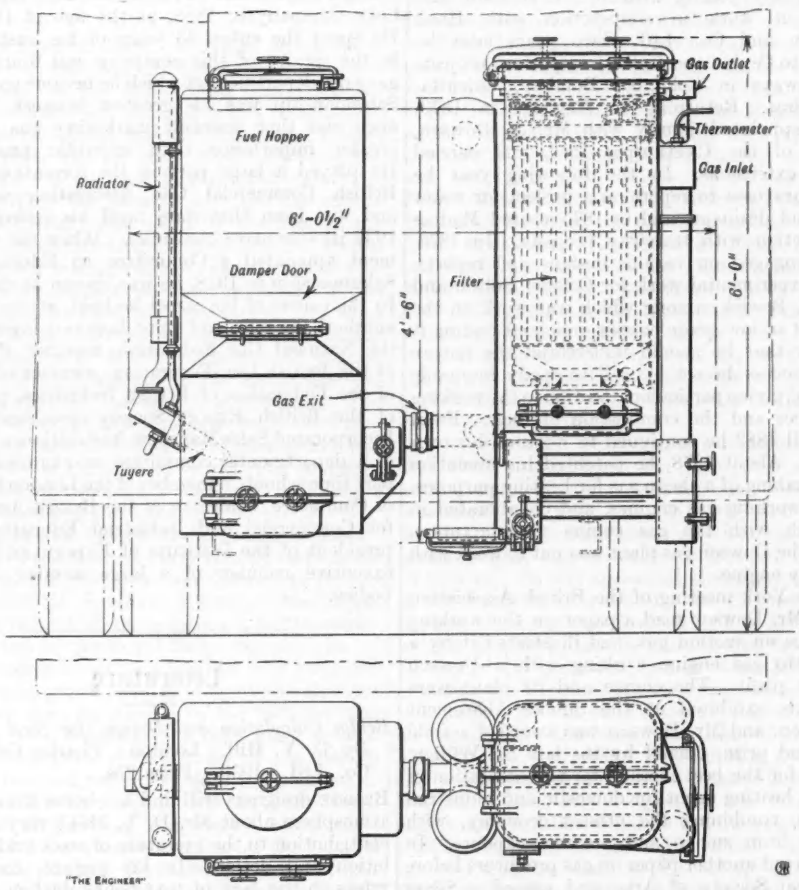


FIG. 4—CONSTRUCTION AND ARRANGEMENT OF PRODUCER PLANT

fitted, and the by-pass is under the control of the driver.

On entering the filter unit the gas passes towards the bottom in an annular space between the outer casing and an inner chamber containing the filtering elements. The direction of flow is twice reversed as shown by the arrows on the drawing, with the object of encouraging the shedding of moisture and impurities before the gas rises through a filtering medium of granulated cork. Above this medium is suspended a series of plates covered with flannel, through which the gas passes from the outside to the inside of the elements so formed. The arrangement is such that the plates, which are rigidly fixed at the top, are free to vibrate under the influence of vehicle movements, so that accumulations on the outside of the elements are shaken off and drop to the bottom of the filter unit. Finally, the gas passes through a security filter at the top of the unit, and is drawn off through the outlet. The filter unit is provided with a hinged cover plate, enabling the whole of the filter element assembly to be withdrawn quickly for cleaning.

In Fig. 5 is shown the construction of the mixing valve and three-way cock designed by Gas Producers (Bellay), Ltd. The mixing valve consists of a branched pipe into which the gas from the producer enters through a large-diameter branch, and the combustion air through a smaller branch, provided with a butterfly valve. A swirling motion is imparted to the air by the vanes shown. No blower is provided for starting up the plant, and therefore a small petrol carburettor is fitted to the three-way valve. When starting up, the butterfly air valve is closed, the gas generator lit, and the three-way cock opened to communicate with the carburettor, so that the engine can be started on petrol. The three-way valve is so designed that by partial rotation the inlet manifold can be in communication with both the carburettor and the gas pipe. When the butterfly air valve is closed, a strong suction can be maintained on the producer until gas comes through in sufficient quantities to operate the engine, whereupon the butterfly valve can be opened, and the three-way valve closed to the carburettor and fully opened to the gas. Since the three-way valve can be under the control of the driver, it will be appreciated that a slight turn of the valve at any time enables the engine to be fed on gas as well as an extra amount of petrol vapour, and by this means an overload on the engine can be sustained, for example, when climbing a steep hill.

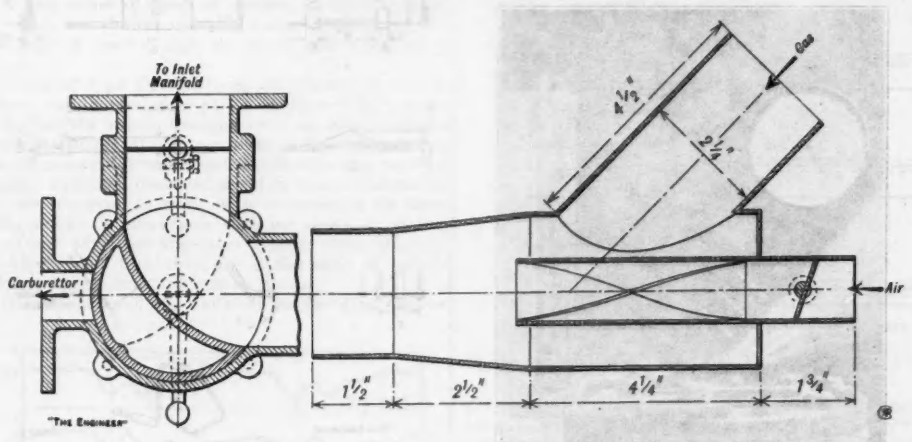


FIG. 5—ARRANGEMENT OF MIXING VALVE AND THREE WAY COCK

It must be emphasised that the converted vehicle illustrated does not comply with existing regulations governing overall length. In this connection, it is reported that the Ministry of Transport will give consideration to applications for exemption from the regulations for the purposes of experimental operation in cases when vehicles are fitted with producer gas equipment and the legal limits are exceeded.

At the time of our visit to the works of the Associated Equipment Company, Ltd., to inspect this plant, we were informed that although associated with Gas Producers (Bellay), Ltd., in the development of the equipment, the firm is not considering, at least at present, the manufacture of new chassis designed to run on producer gas. For at present the Associated Equipment Company holds the opinion that, even in existing war conditions, producer gas equipment will not make appreciable headway until the Government is prepared to give it recognition and offer practical assistance towards its adoption.

The interest of the Ministry of Transport in the use of alternative fuels has so far been limited to an announcement that no objections will be raised to the operation of passenger vehicles drawing trailer-mounted equipment. A further statement that no relaxation of the regulations governing goods vehicles is necessary has only limited application since it is illegal to use a six- or eight-wheeled lorry of maximum overall length with a trailer.

AMERICAN HIGHWAY WORK.—During the year ended June 30th last, 382 railroad highway level crossings were eliminated in the United States, 86 were reconstructed, and 438 provided with warning and protection devices.

American Engineering News

Studies in Iron and Steel

A new specification adopted as standard by the American Society of Testing Materials applies to both bridge and building work and supersedes two former specifications, raising the former requirements for building material to those for bridge material. Also a former specification for unannealed rivets at 75,000 to 85,000 lb. per square inch is superseded by one for rivets of annealed steel at 68,000 to 82,000 lb. tensile strength. In tests of steel rods for suspension bridge wire and of actual bridge wires it was found that the endurance limit was much higher in machined and polished specimens than in those having the original surface—including galvanising for the bridge wires. For the wires the loss was nearly 60 per cent. Stainless steel in architectural exposed construction is found not to stain, corrode or pit, although it becomes covered with a film of soot and dust. But chromium steel is soon discoloured. Tests of railway axles and model axles showed that the endurance limit of the former is little more than half that of the latter. Specifications for cast-iron pipe are nearly ready, after several years of study and experiment. The new steel specifications apply to open-hearth or electric furnace steel, acid bessemer steel being limited to sections not more than $\frac{7}{16}$-in. thick. Carbon is not specified. Phosphorus, 0·04 to 0·06; sulphur, 0·05; copper for copper-content steel, 0·20 per cent. minimum. Tensile strength, 60,000 to 72,000 lb.; minimum yield point, 50 per cent. of tensile strength, but not less than 33,000 lb.; minimum elongation in 8 inches to be 1,500,000 divided by tensile strength, or 22 per cent. Finished eye-bars, unannealed, 67,000 to 82,000 lb. tensile strength; yield point, not less than half the tensile strength, or not less than 36,000 lb. Elongation in 8 inches, 1,500,000 divided by tensile strength; elongation in 2 inches, 20 per cent. of that for 8 inches.

Press Tool Illumination

While there have been great developments in industrial lighting, a survey of the American Illuminating Engineering Society indicates that average factory lighting conditions are far below the desirable efficiency. For power presses it is recommended that the light should come from two sources. The first is to illuminate the area in front of small presses, and to serve the stock and material handling. The second is to give effective illumination on the dies, and for small presses it should be preferably at the rear, where it will not interfere with manipulation. The interior of the press frames should be painted a flat or dead white to increase the contrast between stampings and background. Large presses are operated from both front and rear, so that general illumination is required over the entire floor area. Further, many such machines are in areas served by overhead cranes, so that lighting units are 40 to 60ft. above the floor. A good layout of high-bay reflectors will give a diffused illumination of 10 foot-candles at the floor, and reflectors on the underside of the crane will offset its blocking of the overhead lights. For the supplementary lighting at the dies, a 100-watt spot-light will give a beam of 1500 to 2000 candle-power, with a spread of 30 to 40 deg., and 45 foot-candles on a plane 6ft. from the light source. Such a beam of light is usually preferred by operators to a diffusing reflector. For minimum foot-candles on the dies, the recommendation is 15 for shearing, forming, and bending; 10 for stock handling; and 25 for die repairing on large presses.

Unionising the Construction Industry

A movement which is expected to have serious results for contractors and the construction industry in general is that for gathering all workmen in this industry into labour unions. Many of the skilled trades already have their unions, but the present aim is to include the unskilled, semi-skilled, and labourers. This movement is not unselfishly in the interests of the men, but is largely a strategic movement by the newer and more radical of the two labour organisations which are now in open warfare. The men will get little benefit and their employers will suffer financially, with the net result that they will try to get along with smaller forces. About two million unorganised construction workers are to be covered by this unionising move. It is claimed that it will give more efficient distribution of labour and eliminate the inter-union jurisdictional fights, in which the employers suffer as "innocent bystanders." But the leaders have shown no power or ability to control minor officials and local unions who strike as and when they please, and to whom instructions from superiors or contracts with employers are mere scraps of paper. Furthermore, the leaders themselves have little regard for contracts or agreements, and their conduct of negotiations and strikes is more arbitrary and aggressive than any tactics employers have used. Damage and destruction of life and property are regular factors in disputes with employers or with fellow unions. In fact, public opinion of organised labour is widely unfavourable as the result of the methods now employed, which amount to warfare and riots. It is very evident that the present move will meet strong opposition from the men's unions and from builders and contractors, while the non-union men do not appear generally favourable to the scheme although they may accept it under pressure.

Earthquake Resistant Chimneys

In recent American discussions on the design of buildings for earthquake resistance, a special type of structure considered was the tall free-standing chimney, and investigations noted have indicated that the action of such chimneys is not similar to that of a free, prismatic rod subject to a single force, as has been suggested. In an investigation of the earthquake resistance of a reinforced concrete chimney 222ft. high, the resisting moment was computed assuming that it would fail when the stress in the steel reached 30,000lb. per square inch, and the shearing resistance was computed on the assumption that the concrete would crack when stressed beyond 50lb. per square inch in shear. The zone in which the active moments exceeded the resisting moment was essentially the same for both the impact moment and the vibration moment. For many years engineers accepted the conclusion that free-standing chimneys would break usually at two-thirds of their height, but in a Japanese earthquake, where 240 chimneys were affected, 110 were totally wrecked and 40 seriously damaged, but the point of rupture varied extremely, occurring at almost any point in the height. It is now believed probable that the earthquake fracture of tall chimneys is due to the effect of vibration rather than of impact, and results from failure in moment or shear, or a combination of both. It must be recognised, of course, that tall free-standing chimneys of brick and reinforced concrete constitute a special class of structure that is inherently vulnerable to earthquakes. As to foundation conditions it has often been assumed that damage is always greater in soft alluvial soils than in hard rock, but in several earthquakes, like the one in California in 1933, the damage to buildings on alluvial soil was less than to those on older and firmer deposits.

Artesian Wells in a Reservoir

A municipal water supply from artesian wells submerged in a reservoir formed by an irrigation dam is an unusual feature in the water supply of the city of Ogden. The city had a series of 48 wells, of which 24 were equipped with air-lift apparatus, and the natural discharge was 17·25 sec. ft., or 20 sec. ft. with universal operation of the air-lift system. When the valley in which the wells were situated was to become a reservoir by the construction of the Pine View Dam for an irrigation project, the maintenance of the city's water supply became a problem. The plan adopted was to cut off the wells at 10ft. below the original outlet level and to connect them by steel pipes to three 20in. steel collecting mains which discharge into a steel tank encased with concrete. From this tank a 38in. welded steel pipe conduit nearly two miles long connects with a city main. All pipes are from 4 to 12ft. below the bed of the reservoir, and the flow is controlled by a valve on the 38in. main. To prevent air-locking, provision is made for air venting all the wells and the tank, and all the steel vent pipes are connected underground to a single main laid under the bed of the reservoir and leading to an outlet above the flow-line level. As the reservoir filled, the artesian head increased and became greater than that due to the reservoir, so that there can be no flow from the reservoir to the underground source of the wells. The depth of water over the wells is about 55ft. When the new works were completed the flow from the artesian basin was increased to 24 sec. ft., or an increase of 39 per cent. over the original natural flow and 25 per cent. over the flow with air-lift system in operation. There were several private wells, but all these were closed and capped several feet below the ground in order to close all uncontrolled channels opening into the reservoir.

Some Researches on Steam Turbine Nozzle Efficiency*

By HENRY LEWIS GUY, D.Sc., F.R.S., M.I.C.E.

No. I

THIS series of lectures was founded in memory of one of the very great men of our race and time, who worthily ranks with Newcomen, Watt, and Stephenson.

The three preceding lectures have rightly been given by those who, from their own intimate associations with Sir Charles Parsons, could speak with personal authority of his great engineering and scientific work, with which they were themselves concerned.

When I received the honour of your invitation to

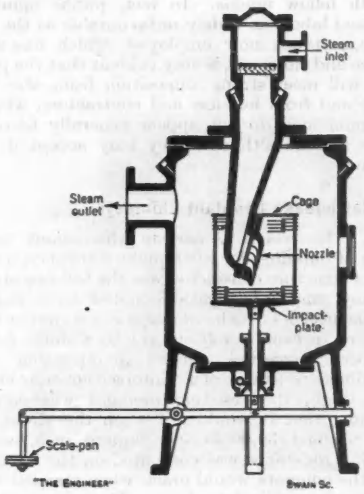


Fig. 1—*Nozzle-Tester of the Institution of Mechanical Engineers Steam-Nozzles Research Committee*

give this lecture, while I hoped that other personal associates with Parsons in his life's work would have further opportunity of adding to our knowledge of his methods and achievements, I realised that, as time goes on, others like myself must of necessity turn to what is the ultimate object of the foundation, which in the trust deed is stated to be "An annual lecture in any of the subjects in which Sir Charles Parsons was interested."

In this manner an annual occasion is provided for the specific discussion of such subjects, and this perhaps can be honoured most fittingly by the

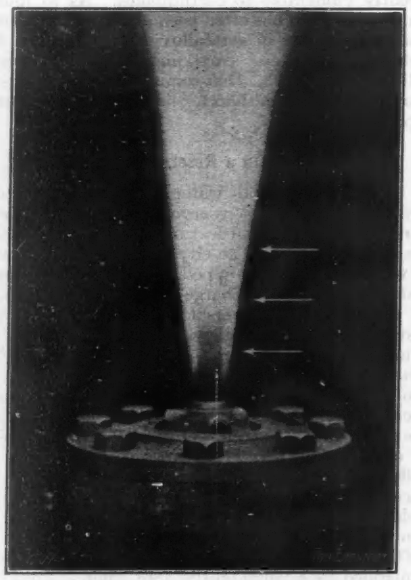


Fig. 2—*Discharge of Steam from Straight Circular Nozzle*

endeavour—however imperfectly achieved—to make some contribution to the knowledge of some aspect of one such subject.

If I sought a text for my own remarks, I could find none more suited to my purpose than the quotation from Parson's own words with which Sir Frank Smith concluded the first Memorial Lecture—"When you think you know everything about a thing, make some experiments and find out more about it."

Although in the years which preceded the work of the Steam-Nozzles Research Committee of the Institution of Mechanical Engineers,† and during its progress, a voluminous literature of researches on the flow of steam through nozzles accumulated, no scheme of research was so exhaustive or so well planned, and none stimulated my interest or illuminated my own mind to the same extent.

Whilst this work gave a great impetus to further research by individual designers, little notable contribution to the knowledge of this subject has since been published.

It may be of interest to trace from this starting point the main lines of research which have increased

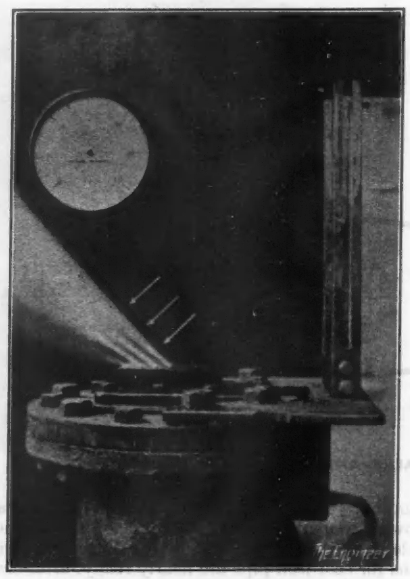


Fig. 3—*Discharge of Steam from Inclined Turbine Nozzle*

my own knowledge or modified our deductions. I propose to do so on the basis of work with which I have been directly connected, as it is of such work only that I have the precise and intimate knowledge necessary to appreciate its lessons and its limitations.

The apparatus employed by the Institution of Mechanical Engineers Committee consisted essentially of an impact-plate on which was placed a pad of wire netting some ¾in. thick, whilst above it was carried an approximately circular "cage" of horizontal slats intended to secure the necessary condition for accuracy that all steam leaving or re-entering the space within the cage should do so in directions parallel to the plane of the impact-plate at the bottom.

The impact-plate with its cage was mounted on a vertical axis and carried by a spindle passing through a long rotating bush fed with oil, which ingeniously provided a relatively frictionless gland and bearing.

Forces transmitted through the spindle were measured by weighing at the end of a lever opposite that to which the spindle and impact-plate were attached, Fig. 1.

A condition for accuracy was that the direction of the steam-flow of the nozzle under test should be perpendicular to, and central to, the impact-plate.

It was therefore necessary to know the direction in which the steam issued from the nozzles by observing the discharge from these in open air when passing steam (preferably wet). The appearance of such a stream of steam flowing from a simple straight-axis convergent nozzle is shown in Fig. 2, in which the nodes associated with acoustic waves in the stream are clearly visible. Here no problem arises in obtaining the correct setting.

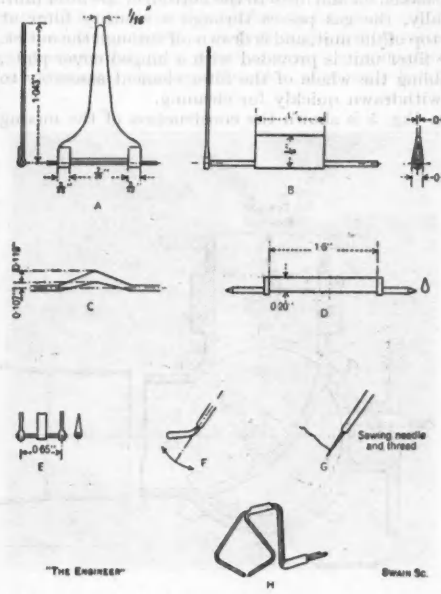


Fig. 4—*Various Types of Vanes to Measure Direction of Steam-Flow*

In the case of the "inclined" nozzle which must be used in steam turbines, the direction of flow cannot be accurately predicted from the shape of the nozzle, except in so far as experimental observation has permitted correction-rules to be obtained by which the approximate direction of flow may be deduced from the geometry of the steam-passage. The character of such a stream of steam is shown in Fig. 3, in which, again. the nodes in the stream are clearly visible.

The stream is not clear cut at its boundaries, friction with the surrounding air causing a fringe of less dense steam to break away from the main flow. Since in most turbines the stream of steam is continuous for the whole circumference, this effect at the ends introduces into such nozzle-tests losses which do not arise in a turbine itself. On the other hand, this effect at the inner and outer peripheral surfaces of the stream takes place to a certain extent in a steam turbine.

As, however, the predictions based on "good" tests in the nozzle-tester agree reasonably well with the results obtained in a turbine itself, the effect of these fringe losses does not entirely vitiate the utility of this method of test when used with experienced judgment. On the other hand, the relatively great length of the free jet, from the nozzle to the impact-plate, is responsible for some of the

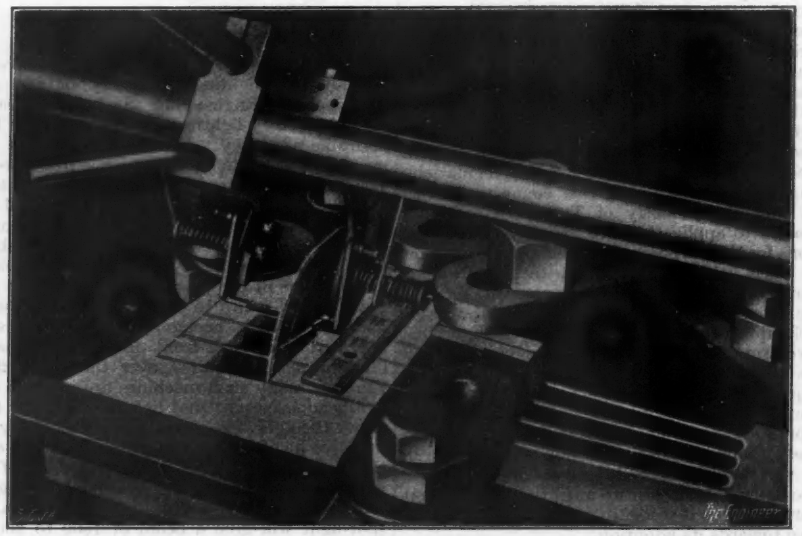


Fig. 5—*Measurement of Efflux Angle by means of a Vane of Type D (Fig. 4)*

*The Sir Charles Parsons Memorial Lecture, 1939.

† The Steam-Nozzles Research Committee of the Institution of Mechanical Engineers will subsequently be referred to by the initials S.N.R.C.

difficulties which it is now recognised follow from the use of this type of apparatus.

At the time of the issue of the six Reports of the Steam-Nozzles Research Committee,[1] I, in common with the Committee and others, felt that the apparatus was reasonably free from error arising from differences in the distance of the centre of the stream of steam from the impact-plate.

In view of the greater accuracy of measurement now desired and obtained, later and almost continuous work on a nozzle-tester based on the S.N.R.C. design has modified that opinion. It is probable that in the distance of the nozzle face from the impact-plate lies one of the causes of the anomalous results sometimes obtained.

Whilst the S.N.R.C. explored the mean direction of stream-flow from inclined nozzles by means of cotton threads or long vanes of type A (shown in Fig. 4), it has been necessary since that date to devise means of measuring more accurately the direction of flow in different parts of the stream from the nozzle and at distances as close to its outlet face as is usual to the entry of the moving blade it supplies.

A long series of trials of various methods, several of which are shown, has now reduced our choice to the type of vane D and the small yaw-meter H of Fig. 4.

Vanes of type D, which are practically free from flutter, can be used close up to the face of the nozzle, and gives the mean direction over an axial distance of about 0·05in. It is shown in use in Fig. 5, measuring the efflux-angle from a short length of a long moving blade. For such observations it is more comfortable for the observer to work with compressed air than with steam; observations with air apply to steam-flow, but at steam-velocities greater than the air-velocity of the test, they are in the ratio of sound-velocity in the steam to that in the air.

The character of the variation in direction of flow

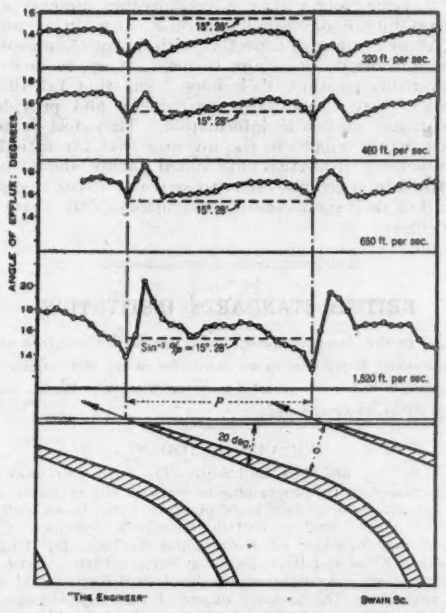


Fig. 6—*Angles of Efflux from Turbine Nozzles*

over a typical nozzle-stream from an impulse-type nozzle whose geometrical angle was 20 deg. and which was supported by two neighbouring nozzle-streams, is shown in Fig. 6, with the characteristic changes as steam-velocities are increased from 320ft. per second to 1520ft. per second.

At intermediate velocities the direction of flow varied continuously as velocities were increased between those values and arrangements.

The dotted line on each figure shown at an angle of 15 deg. 28 min. corresponds to $\sin^{-1} o/p$, where o/p denotes (throat-width)/(vane-pitch), and shows how reasonably well this relation, suggested during discussion of the S.N.R.C. Reports, agrees with the mean observed value. The test is typical of the correspondence we usually find between test results on good nozzles and the application of this simple relation. In fact, the degree of agreement with the mean angle predicted by this relation is often a rough measure of the efficiency of a nozzle.

There is no doubt that the publication of the first results of the S.N.R.C. was sensational, because it appeared to establish a shape of characteristic for the variation in velocity-coefficient of a nozzle with velocity of the steam which was markedly different from conceptions then currently held.

The actual curves for the first nozzles tested, with a 20-deg. nominal angle and made from thin plate 0·04in. thick, are reproduced in Fig. 7. The most important curve is that for a throat-length of 0/1, Fig. 7, for these researches soon established that long

[1] First Report. Proc. I. Mech. E., 1923 (Vol. i, Jan.–June), p. 1. Second Report. *Ibid.*, p. 311. Third Report. *Ibid.*, 1924 (Vol. i, Jan.–May), p. 455. Fourth Report. *Ibid.*, 1925 Vol. ii, May–Dec.), p. 747. Fifth Report. *Ibid.*, 1928 (Vol. i, Jan.–May), p. 31. Sixth Report. *Ibid.*, 1930 (Vol. i, Jan.–May), p. 215.

throats were a source of undue loss, and their use was generally abandoned. The significant features of the characteristic were :—

(1) a rapidly rising curve as velocity was decreased from 700 to 300ft. per second ;
(2) a valley at about 700ft. per second, followed by
(3) a rise to a second maximum of efficiency at a velocity of about 1350ft. per second (86·5 per cent. of sound-velocity), followed by
(4) a second valley at about sound-velocity 1560ft. per second, with
(5) a further rise in efficiency beyond sound-velocity.

Earlier researches had rarely attempted the task

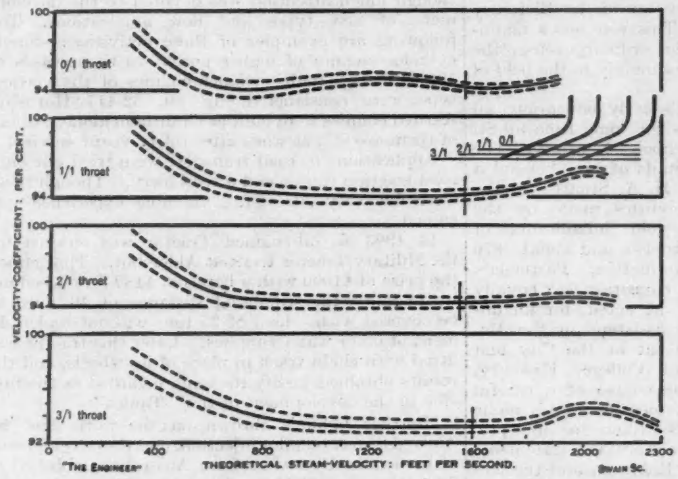


Fig. 7—*Characteristics of S.N.R.C. 20-Degree Impulse Nozzle, made from Thin Plate 0·04 in. thick*

of tracing the characteristics of a turbine-type nozzle down to the lower range of velocities covered by the S.N.R.C. tests, a region where experimental difficulties increased very rapidly. Typical earlier published results are those shown in Fig. 8, due to Professors E. Josse and P. Christlein,[2] G. Flügel,[3] and Mr. Escher Wyss.

Those of Josse and Christlein showed a curve rapidly rising with velocity to a point beyond that of sound-velocity. Flügel, starting with an experimental curve obtained for a high range of velocities, showing

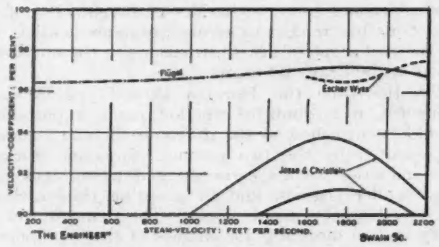


Fig. 8—*Certain Characteristics from Researches made prior to the S.N.R.C. Tests*

the same but a flatter tendency, continued it backwards by an analytical speculation, with a slowly dropping curve as zero velocity was approached.

As these kinds of characteristics were generally accepted, and those of Josse and Christlein had had great weight on turbine design for some years, it was natural that the effect of the S.N.R.C. curve was profound.

It is now no secret that turbines designed on the basis of the characteristic exhibited by Josse's and

TABLE I.—*Various Arrangements of Blading with a Selected Steam-Velocity for a 10,000-kilowatt Turbine*

Steam conditions : Pressure, 250 lb. per square inch gauge ; temperature, 600 deg. Fah. ; vacuum, 28½in. of mercury.

Steam-velocity.	Number of stages.	Mean diameter.	First-blade height.	Last-blade height.	Diagram in Figs. 9.
ft. per sec.		in.	in.	in.	
400	136	13¾	2·94	292	(*a*)
1250	14	43	0·36	30	(*b*)
1800	7	62	0·21	10·5	(*c*)
400	45	13¾	2·94	—	(*d*)
1250	9	43	—	30	
400	45	13¾	2·94	—	(*e*)
1250	5	43	—	—	
1800	2	62	—	10·5	

Christlein's results, requiring, as they did for high efficiency, a very small number of stages running at a very high peripheral velocity, proved disappointing

[2] *Discussion by Professor Josse*, "Neue Versuche über Strömungsvorgänge und ihre Anwendung bei Dampfturbinen, Kondensationen und Kälteerzeugung." Zeits. Ver. Dtsch. Ing., Vol. 55 (1911, part 2), p. 2072. *Report by Professor Christlein*, "Untersuchungen über das allgemein Verhalten des Geschwindigkeitskoeffizienten von Leitvorrichtungen des praktischen Dampfturbinenbaues." *Ibid.*, p. 2081.

[3] "Die Düsencharakteristik." Forschungsarbeiten No. 217 (1919), p. 18.

in efficiency, and, as a result of the necessarily high peripheral speeds of the blades, both difficult and dangerous machines.

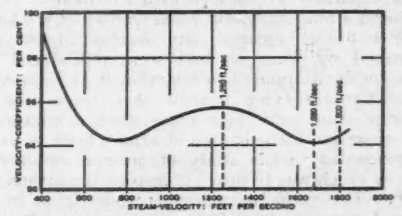
If the shape of the characteristic shown in Fig. 9 were in fact correct, then naturally a designer would, if possible, endeavour to adopt steam-speeds of, say, 400ft. per second to obtain highest efficiency.

Unfortunately, the geometrical requirements of the blading of a turbine based on such a velocity would be impossible, even for the relatively low ratings and steam conditions usual at the time.

It must be remembered that the total volume passing through a modern machine increases some 450 times for what would now be standard steam conditions. Of course, the area provided through the last row of blades should in such a case also be 450 times that through the first row if the velocity of the steam is maintained the same in both cases. Even with steam conditions quite usual at the date of the issue of the Second Report of the S.N.R.C. (1923), such as a pressure of 250 lb. per square inch gauge, a total temperature of 600 deg. Fah., and a vacuum of 2½in. of mercury, an impulse turbine designed for 10,000 kW at 3000 r.p.m. would require the phenomenal number of one hundred and thirty-six stages, with a first-blade height of 2⅞in. on a mean diameter of 13¾in., and a last-blade height of 300in. on the same mean diameter; those were utterly impossible conditions for design or manufacture, or for that matter even to draw, as will be seen from Figs. 9 (*a*).

If the second optimum in efficiency at a velocity 1250ft. per second were chosen for the same conditions, fourteen stages would be required, with a first-blade height, smaller than desirable, of ⅜in. on a mean diameter of 43in., whilst a last-blade height of 30in. on that diameter would again be impossible—Fig. 9 (*b*).

Again, if advantage were to be taken of the third rise in efficiency at a velocity of 1800ft. per second, six to seven stages only would be required, with the quite attractive last-blade height of 10½in. with a



S.N.R.C. CHARACTERISTICS FOR THIN-PLATE IMPULSE NOZZLE, DERIVED FROM EARLY RESEARCHES.

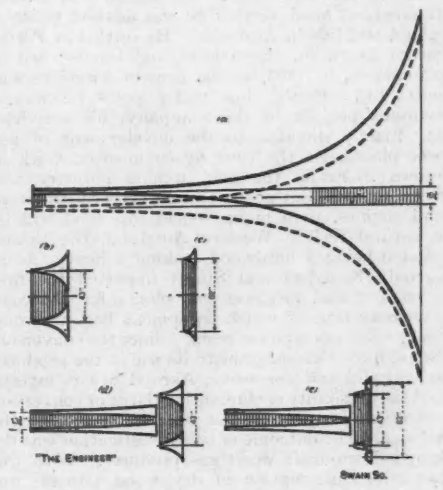


Fig. 9—*Geometrical Requirements of Turbine Blading for Assumed Steam Conditions and Nozzle Characteristics shown above*

mean diameter of 62in., but with the undesirably small first-blade height of 0·2in., Figs. 9 (*c*).

Acceptance of this characteristic, therefore, naturally led many designers to construct turbines which would work with low velocities of from 300 to 500ft. per second on small diameters at the high-pressure end, and directly this approach became geometrically impossible to step up at once to the relatively large diameters required with steam-speeds of between 1200 and 1800ft. per second, as shown in Figs. 9 (*d*) and (*e*). These figures are summarised in Table I.

Where such constructions were carried to extremes of low speed and small diameters at the high-pressure

Herbert Akroyd Stuart and the Development of the Heavy Oil Engine*

By T. HORNCASTLE, B.Sc., Assoc. M.I.C.E., and A. K. BRUCE, M.I. Mech. E., Mem. A.S.M.E.

Biographical Memoir.—Herbert Akroyd Stuart was born at Halifax, Yorkshire, on January 18th, 1864. He was the son of a Scotsman, Charles Stuart, who came from the neighbourhood of Paisley. Charles Stuart, a man of marked inventive ability, possessed of private means, occupied himself in engineering work of an experimental kind. He ultimately settled in Bletchley, Buckinghamshire, where he had a small factory known as Bletchley Iron and Tin Plate Works. This was not a manufacturing establishment in the ordinary sense, the activities carried on there being mainly in the field of experimental engineering.

Of Herbert Akroyd Stuart's early education, all that is known is that he was for some time at St. Bartholomew's Grammar School, Newbury. The school records contain no details of him beyond a bare reference to the name "H. A. Stuart" in the school register of 1876. Enquiries made by the present Headmaster among old inhabitants of Newbury who were at the school in and about 1876 have failed to produce any information. Particulars of Akroyd Stuart's technical education are equally vague, but it is certain that he acted, for an unspecified period, as a junior assistant in the Mechanical Engineering Department at the City and Guilds of London Technical College, Finsbury, London. Nevertheless, in the course of a careful search made during 1939, no mention of his name could be found in the records, which are now preserved at Gresham College, London. The statements of the late Professor William Robinson and the late Professor Sylvanus P. Thompson are, however, authoritative as to Akroyd Stuart's connection with the Mechanical Engineering Department at Finsbury. On leaving Finsbury Technical College, Akroyd Stuart joined his father at Bletchley Iron and Tin Plate Works, where the experiments culminating in the development of the Akroyd engine were carried out.

In the account which he wrote of "Heavy-Oil Engines of Akroyd Type," the late Professor Robinson relates that Akroyd Stuart was guided to the investigation of oil engines by an accident which happened to him at Llanelly. This was in 1885, the occasion being the accidental spilling of oil from a paraffin lamp. The oil fell into a tinning pot and, being vaporised by contact with the molten metal, produced a mild explosion when ignited by the lamp. Akroyd Stuart escaped any serious injury but, impressed by what he had seen, reproduced the explosion by dropping more paraffin on to the molten tin. Thus satisfying himself that there was no mystery about what took place when a mixture of oil vapour and air is ignited at atmospheric pressure, he proceeded to the study of internal combustion engines which was to prove of historic importance.

After the exclusive manufacturing rights in the Akroyd patents had been acquired by Richard Hornsby and Sons, Akroyd Stuart took little further interest in the oil engine. His health was always indifferent, so much so that he was advised to leave England and live in Australia. He settled at Perth, Western Australia, about 1899, and became one of the founders, in 1903, of the firm of Saunders and Stuart, Ltd., Perth. For many years he was a consultant partner in this company, his activities being mainly directed to the development of gas power plant. At the time he commenced work in Western Australia the gold mining industry was developing well, but power costs, whether with steam or oil engines, were high. Wood was (and still is) the natural fuel in Western Australia, the timber available being a hardwood making a heavy, dense charcoal. Saunders and Stuart imported the first gas engines and producer gas plants for charcoal, the introduction of which equipment had a revolutionary effect upon power costs. Since the conversion of wood into charcoal prior to its use in the producer was wasteful and expensive, Akroyd Stuart investigated the possibility of eliminating the prior conversion to charcoal by putting the wood directly into the producer. The outcome of this investigation was the Akroyd down-draft wood gas producer. With this plant, the consumption of dry wood (Mulga) was approximately 2 lbs. per B.H.P.-hour against approximately 1 lb. of charcoal per B.H.P.-hour. Since the conversion to charcoal called for approximately 5 lbs. of raw wood per lb. of charcoal, the resulting nett economy was very large, and plants for supplying gas for the development of many thousands of H.P. were supplied to the gold mining and other industries.

Akroyd Stuart, who never married, died at Claremont, Western Australia, on February 19th, 1927. He left directions that after his death, all his papers, drawings, and models were to be destroyed, an instruction which was duly carried out by the executors of his will. Akroyd Stuart's patent specifications Nos. 7146 and 15994 were applied for in 1890. These are the patents covering, respectively, the automatic ignition engine with injection at the end of compression, and the engine subsequently built by Messrs. Richard Hornsby and Sons as the Hornsby-Akroyd engine. The engine embodying these patents was placed on the market and was an immediate success. It was a single cylinder horizontal type engine, manufactured in sizes from 1½ to 16 H.P. In 1896 the water-jacket vaporiser was fitted, enabling the compression pressure to be raised and the power of the engine to be increased. The 16 H.P. engine, as originally manufactured, became a 20 H.P. when fitted with a water-jacketed vaporiser. From this time on, little modification was made to the fundamental design of the Hornsby-Akroyd oil engine, though much attention was devoted to the development of new types and new applications. The following are examples of these activities:—Single cylinder engines of higher power up to upwards of 100 H.P. and multi-cylinder engines of the vertical type were constructed. In all, 32,417 Hornsby-Akroyd engines were built at Grantham alone. Many of them are still at work after thirty years' service.

Applications to road transport were tried out on a road traction engine and a road lorry. Though these were not very successful, valuable experience was gained.

In 1903 an oil-engined Tractor was entered for the Military Tractor trials at Aldershot. This gained the prize of £1000 with a bonus of £180 for exceeding, by 18 miles, the stipulated distance of 40 miles to be covered with a load of 25 tons without replenishment of oil or water supplies. Later this tractor was fitted with chain track in place of its wheels, and the results obtained justify its being regarded as the first step in the development of the "Tanks."

[Further light is thrown on the work done by Akroyd Stuart on pilot injection, and the development of his engine by letters from Australia, published in THE ENGINEER of November 4th, 1921, and June 1st and October 12th of 1923. The last-named letters of Ackroyd Stuart deal mainly with oil engine nomenclature, but go to show that the general ideas leading to the compression-ignition engine were formulated by him.—ED. THE ENGINEER].

The Work of Akroyd Stuart in Relation to Later Developments.—The importance of the work done by Akroyd Stuart has been obscured by the operation of a number of circumstances. To begin with, the indifferent health of the inventor caused him, while still a young man, to leave this country and settle in Western Australia. Again, the immediate success of the Hornsby-Akroyd engine and the brevity of the period (about one year) during which Akroyd Stuart was in personal contact with Messrs. Richard Hornsby and Sons has tended to create misunderstanding as to the real scope of his contributions to the development of the heavy oil engine.

At the time the Hornsby-Akroyd engine was launched, it is doubtful whether much importance would be attached to the difference in fuel timings represented by the two patents. Injection during the induction stroke certainly had advantages for the smaller engines, and in adopting this method Messrs. Hornsby acted wisely. The demand which they had to meet was for engines of the type popularised by the advent of the Crossley gas engine, in which simplicity, reliability, and low first cost were of greater importance than high thermal efficiency. The alternative method of injection would have brought no advantage without a considerable increase in the compression pressure involving great mechanical difficulties. These difficulties, as we now know, were only overcome—at vast labour and expense—by the pioneering work of many individuals.

What Akroyd Stuart accomplished is best understood from a study of his work in its relation to the contemporary state of the art. Eminently the practical type of engineer, almost every move he made is very clearly the result of experiment. He was the first man who, so far as we know, described the cycle of what has come to be called the compression-ignition engine. Although in the engine which he constructed a proportion of the heat required to raise the temperature of the air was obtained from the vaporiser, the final ignition temperature, and consequently ignition control, was obtained by compression.

The combustion chamber with contracted neck was certainly among the happiest of all Akroyd Stuart's intuitions, since by these so simple means he was able more or less to stabilise the ignition, and secure good combustion over a wide range of speeds and loads. To-day, with injection arrangements of a perfection undreamt of fifty years ago, the precombustion chamber has become a familiar device on small quick-revolution engines. Notwithstanding the advantage which it gives in such important design conditions as those relating to injection pressure, the fuel consumption of small high compression engines thus fitted is, fuel for fuel, approximately the same—due doubtless to turbulence effect and the suppression of late burning—as for engines of comparable size and speed with direct-injection combustion chambers. It must also be remembered that when Akroyd Stuart first adopted the vaporiser with contracted neck, compression pressures were very low, whereas to-day compression pressures (and mean effective pressures) are out of all proportion higher.

The water-jacketed vaporiser enabling the compressing to be increased was an important step towards the final goal of heating the air by compression alone, and made this ultimate development inevitable. In this connection it is interesting to note the parallel exploitation of the Akroyd patents in the United States of America. These were taken up by the De La Vergne Machine Company, and in 1893 Mr. A. H. Goldingham was sent out by Messrs. Hornsby to assist in the development of an engine on the lines of the Hornsby-Akroyd. An engine was produced which, though similar in principle, differed considerably in the detail design. This engine was taken up by the oil companies for pipe line pumping work, for which it proved most successful. Here the use of crude oil was desirable and, in order to enable the fuel to be utilised, the compression pressure was raised and the proportion of unjacketed vaporiser decreased. This line of development was followed until a compression pressure of 330 lb. per square inch was reached and an engine produced with the characteristics of the modern heavy oil engine. In the Akroyd engine, working with fuel injection at the end of the compression stroke, ignition control was obtained by compression rather than by timing of the injection. Some years were to elapse before there had evolved an engine which, in general essentials, closely resembled the heavy oil engine in use to-day. Nevertheless, the inventive steps taken by Akroyd Stuart are such as must cause us to marvel at the prescience which, fifty years ago, enabled him to see so clearly and so far.

Conclusion.—In the preparation of this paper, the authors have been actuated by a desire to arrive at a clear understanding as to the part played by Herbert Akroyd Stuart in the development of the heavy oil engine. In studying the information and documents available to them they have found that a considerable amount of uncertainty and misunderstanding exists in regard to Akroyd Stuart's connection with this development. The authors do not claim to have set up an incontrovertible position, their hope being that full discussion may correct any inaccuracies and provide additional authentic information. They feel it to be a fitting tribute to the inventor that the fiftieth anniversary of his two most noted patents should be marked by a genuine effort to arrive at a true assessment of their significance in the history of the heavy-oil engine.

* Extracts from a paper read before the Diesel Engine Users' Association on Thursday, January 11th.

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PRECISION TOOLS

(B.S. Nos. 863, 869, and 870).—The British Standards Institution, in its programme of work in the preparation of specifications for engineers' precision tools, has recently issued three further British Standards, namely, for Steel Straightedges of Rectangular Section, for Toolmakers' Flats and High Precision Surface Plates, and for Micrometers. As in the case of the other British Standards in this series, the primary object of these specifications is to prescribe standards of accuracy, and the specifications have been prepared with the co-operation of the manufacturers and in close collaboration with the National Physical Laboratory. The Standard for Steel Straightedges, No. 863, applies to straightedges of rectangular section up to 6ft. in length, such as are used on surface tables and for testing the alignment of machine tools. Provision is made for two grades of accuracy, limits of straightness, parallelism and flatness being prescribed, whilst minimum sections are also specified. Two informative appendices are included on the subjects of the manner of using such straightedges to obtain the greatest degree of accuracy and on the testing of straightedges. The Specification for Toolmakers' Flats and High Precision Surface Plates No. 869, deals with steel flats of diameters from 2in. to 6in., and circular cast iron plates of 10in. and 14in. diameter. The permissible errors in flatness range from 0·00002in. to 0·00004in. according to the size of the flat or plate. Some general requirements are included relating to the material and to the overall dimensions. The Specification for Micrometers, No. 870, relates to external micrometers with measuring ranges from 1in. to 12in. and from 25 mm. to 300 mm. Permissible errors are prescribed in respect of the flatness and parallelism of the measuring faces, the zero reading, the error in the micrometer screw, and the alignment of the spindle and anvil. A section of the specification relates to setting gauges, whilst an extensive appendix gives recommended methods for testing the measuring faces and for the calibration of the micrometer screw.

SHIPBUILDING AND MARINE ENGINEERING IN 1939.—On page 46 of our previous issue it will be noticed that the captions to the cross-channel vessels "Vecta" and "Princess Victoria" have become transposed.

ROADS, BRIDGES AND TUNNELS IN 1939.—In the issue for January 5th, 1940, page 24, centre column, sixteen lines below the engraving illustrating Howrah Bridge, the following sentence was printed. "This falsework will eventually be counterbalanced by the cantilever arm . . ." For "falsework" read "steelwork."

end, or to very large diameters at the low-pressure end, it is now, I suppose, no secret that once again the resulting turbine-efficiencies were disappointing in spite of the encouraging names given to them by their progenitors.

(*To be continued*)

A Rural Oil Circuit-breaker

THE design of a rural circuit-breaker involves special considerations which may be classified under the headings of those features necessary to produce satisfactory service with regard to dielectric and mechanical reliability, short-circuit interruption, maintenance, and convenience to the supply undertaking.

Normal insulation levels for 6·6 and 11 kV are unsuited to this class of gear. The comparatively low oil volume and the probability of infrequent maintenance are likely to result in greater deterioration of the dielectric strength of the oil than with other classes of circuit-breakers. Moreover, the over-voltage stresses, chiefly through lightning surges, to which rural gear may be subjected are higher in relation to the service voltage than those associated with 22 or 33 kV systems. Another point regarding dielectric strength is that this value should not be critically affected by small losses of oil through incorrect filling or insufficiently tightened rain cocks allowing seepage.

To ensure mechanical reliability, it is essential that the alignment or adjustment of mechanism, particularly in the case of auto-reclose types, is not affected by the rough handling of transport and erection which pole-mounted breakers are likely to

POLE MOUNTED UNIT WITH TANK LOWERED

receive. Means should also be provided to limit the shock which can be transmitted to the delay gear when reclosing. A balance has to be drawn between the space required for the series trip coils, the maximum short circuit current permissible for the section of wire, and the minimum trip value obtainable from the coil. The best use can be made of any coil by having breakers with short total break times, thereby increasing the permissible current through the coil, and by employing efficient magnetic trip circuits to give low tripping ampere-turns, thereby reducing the number of turns for a given trip current.

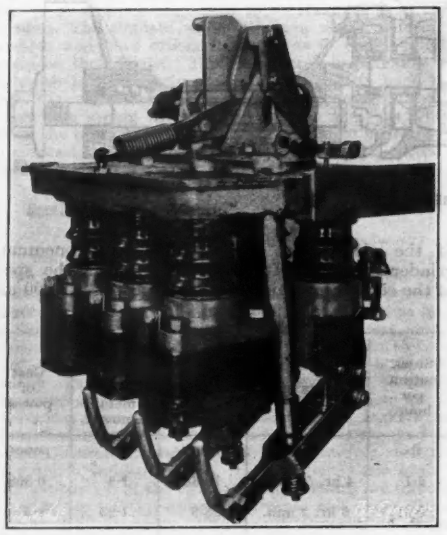
A breaker that passes type-tests in line with the requirements B.S.S. 116/1937 is adequate in respect of interrupting ability for all conditions within its rating. Because of infrequent maintenance and the fact that reclosing breakers may have to operate several times on short-circuit without attention carbon formed during interruption will have time to settle on the insulation, and this, combined with damp, will impair the insulation strength. It is therefore important to reduce the quantity of carbon liberated during short-circuit and to localise as far as possible any deteriorating effect of such carbon.

Maintenance of rural breakers is often carried out in inaccessible situations and unfavourable weather, and it is therefore essential in the design to make all work as easy as possible. Another consideration is the user's convenience as regards interchangeability.

While most engineering designs must necessarily be a compromise between their function and their cost, in the new "GPC" rural breaker manufactured by the Metropolitan-Vickers Electrical Company, Ltd., an attempt has been made to provide all the features indicated in a unit of normal size and reasonable price.

The equipment comprises a sheet steel frame incorporating hanger irons, fitted with a detachable lid from which the circuit-breaker tank is hung by two lowering and raising screws. These screws serve also to secure the tank in the service position. The frame has a sloping shelf on each side, on which may be bolted a unit comprising three single-piece through-porcelain bushings or a 3-phase cable box. These units are readily interchangeable. Bolted to this frame on a 3-point mounting is a malleable sub-frame carrying the complete circuit-breaker, mechanism, and contact assemblies. Distortion of the outer housing cannot therefore affect alignment of breaker or mechanism parts. The sub-frame carries six porcelain posts, three of which mount cross-jet pots. The other three carry efficient trip coil frames and hinge points, to which are pivoted the spring-loaded moving contact assemblies. In this way a balanced use is made of the space available, as may be seen from the illustrations, and the advantages associated with single-break cross-jet operation, hitherto confined to large power station circuit-breakers, are obtained, *i.e.* quick interruption; short total arc length; minimum carbonisation; and confinement of the arc to the cross-jet pots.

The breakers when tested to B.S.S. 116/1937 gave an exceptionally fast interrupting performance, the total break time from initiation of short-circuit to interruption not exceeding three cycles for 11 kV operation, from 10 to 100 per cent. rating. Of this time, one-half represents arc-duration. At lower currents the opening time will be longer, owing to



BREAKER MECHANISM ON SUB-FRAME

suction discs incorporated to prevent tripping on momentary overloads, such as on starting motors, the time becoming approximately five seconds at 130 per cent. normal setting. The advantages of this high speed tripping at larger currents are reduction in system disturbances, contact wear, oil deterioration, and, in the case of overhead lines, in damage to the wires and insulators. In addition, breakers of this speed will clear faults before most classes of relays on the system sub-station breakers have time to operate, even if these be of so-called instantaneous type, without delayed settings.

The easily lowered tanks and lid give access to the contact and mechanism assemblies, which can therefore be readily adjusted and inspected. A new feature is the fixed contact mounting, the contact being withdrawable from the side of the cross-jet pot by undoing only one bolt, without the necessity of dismantling the jet assembly. The moving contact is located by accurate grooves, ensuring alignment, and the minimum adjustment is therefore necessary when changing contacts.

The arrangement of mechanism and trip gear adopted also ensures that the creepage length of the lift-rods and of the trip-rods, which pass through the centre of the series-trip porcelain supports, is the maximum, while all creepages and puncture distances are such that a complete breaker has withstood a one minute, 50-cycle type test of 50 kV. The impulse level is over 104 kV with 1/50 positive waves, flash-over occurring externally. This is an unusually high insulation level to be obtained in a circuit-breaker of normal size, requiring only 11½ gals. of oil.

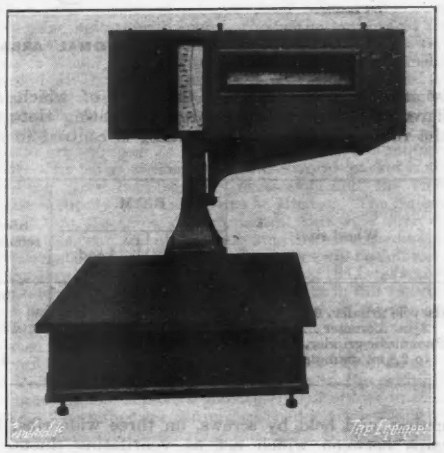
The auto-reclose and hand-close mechanisms are interchangeable on the same sub-frame, or hand-closed units may be easily converted to auto-reclose by adding and changing a few parts requiring assembly work only. The weight operated auto-reclose mechanism is cushioned by built-in compression springs, limiting the shock which can be transmitted to the delay gearing and mechanism. The complete breaker on its sub-frame can be removed by undoing the internal connections to the bushings and also the 3-point securing bolts.

A number of accessories and modified fittings are also available, such as auxiliary switch, shunt trips, definite minimum time delay trips, earth leakage trips, and transformer mounting housings.

Semi-Self-Indicating Weighing Machine

THE accompanying engraving illustrates an interesting type of weighing machine which has recently been passed for trade purposes by the British Board of Trade. It is a semi-self-indicating machine which can be used either as a platform weighing machine raised above the ground or with the platform sunk flush with the floor level. The particular features of the machine constitute a development of the well-known "no loose weight" steelyard machine which is in general use. The makers, Ashworth, Ross, and Co., Ltd., Midland Iron Works, Dewsbury, have made use of their experience in hopper weighing machines by adapting the particular type of indicating mechanism in hopper weighers to the semi-self-indicating machine.

As is necessary with all weighing machines provided with a chart the steelyard must be of the vibrating type so that it takes up a different position according to the load applied. The movement of the steelyard is magnified by means of a long pointer with a fulcrum at its nose end; the pointer is retained by means of a link attached to the steelyard bracket. The movement is damped by means of a dashpot. Charts can be provided having up to 112 divisions ⅛-in. apart, so that in effect the chart takes the place of what would have been the minor poise on an ordinary steelyard machine. The whole of the mechanism is enclosed in a sheet metal casing with a hinged cover through which access is obtained to the major no-loose-weight travelling poise. The operator moves this poise to the correct notch by observing when the pointer comes on to the chart field and reads off the minor graduations on the chart. This overcomes the difficulty of adjusting the minor poises which is the most frequent source of incorrect weighing with the



SEMI-SELF-INDICATING WEIGHING MACHINE

ordinary type of machine. A tare bar can be fitted if desired.

A further use for this type of mechanism is as a "light and heavy" weighing machine for checking a series of equal loads. In this case the chart is marked with a central zero position and graduations above and below represent "heavy" or "light" loads as compared with the given zero position. In this case a minor poise is provided so that any desired weight can be set on the steelyard, the attainment of which automatically brings the indicator to the zero position.

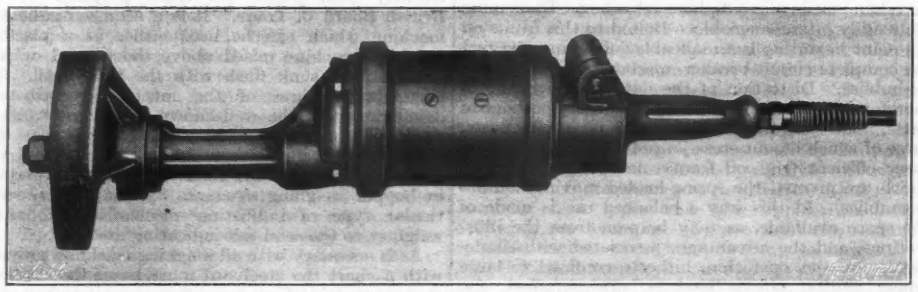
Portable Electric Grinders

DURING a recent visit to the London works of the Consolidated Pneumatic Tool Company, Ltd., at 232, Dawes Road, S.W.6, we had an opportunity of inspecting some of the wide range of "Hicycle" portable electric tools the firm is now producing. These tools work at a frequency of 200 cycles, which gives a maximum rotor speed of 12,000 r.p.m. The adoption of this principle permits a considerable reduction in the weight and size of the motor, whilst it develops the same power as one working at a smaller frequency, and the rotating parts work within safe limits of speed. Much of the weight saved is used to increase the size and strength of the gears, bearings, and other mechanical parts. This gives the tools a long working life and enables them to stand up to severe working conditions. Tools designed under the "Hicycle" principle include a wide range of drills, grinders, polishers, nut runners, sanders, screw drivers, tappers, &c., for all branches of industry.

Two types of rotors are used. One of these, known as the "Uniloy" is in the form of a solid casting in which the alloy windings, having the electrical properties of copper, are cast integral with the core. The other, called the "Ventilated" type, has a number of slots formed along its length with copper strip windings laid inside them. Air drawn along

the slots passes over the whole surface of the copper and the efficient cooling results in an increased power output.

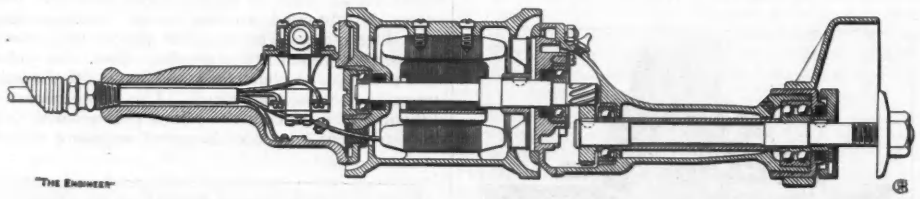
In the accompanying engraving and drawing is shown the arrangement of a typical machine of the



PORTABLE ELECTRIC GRINDER

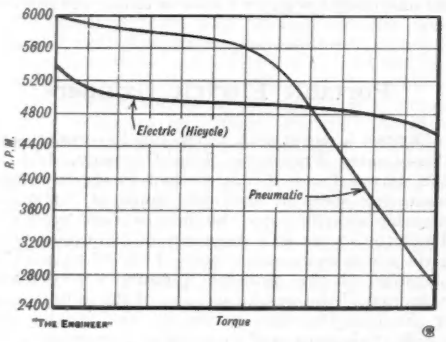
ventilated rotor type. It is one of the company's standard portable grinders intended particularly for heavy work in foundries, shipyards, railway shops, &c.

The stator casing, forming the body of the machine,



SECTIONAL ARRANGEMENT OF GRINDER

is an aluminium casting, the ends of which are flared outwards to form large ventilating slots for the rotor and stator. The stator is centred in the casing, and held by screws, on three wide ribs, the gaps between which act as ventilating ducts. A pressed steel fan on the rotor shaft draws air in through the slots at the handle end of the machine, past the rotor and stator cooling ducts, and out through the slots, in the direction of the grinding wheel. The rotor shaft is mounted in ball bearings set in steel inserts cast integrally in the aluminium castings which form the handle and grinding wheel spindle extensions. Lubricant is retained in the bearings and dust excluded by special seals. Helical teeth cut on an extension of the rotor shaft mesh with a gear keyed to the end of the grinding wheel spindle. The spindle is mounted in ball bearings which are



SPEED-TORQUE CHARACTERISTICS

spaced apart by a sleeve within the grinding wheel extension arm, in addition to the inserts in the castings. A substantial dust proof tumbler switch actuated by a plunger is mounted in a separate compartment, formed adjoining the motor case, in the handle casting. This switch assembly is easily and rapidly withdrawn from its compartment by the removal of two small screws.

These grinders are made for wheels of 6 and 8in. diameter, and can be supplied with extension arms to give overhangs of 20 and 36in. They are also made with right angle grinding heads for working on large surfaces.

Tests have been made by the company to ascertain the comparative performances of its standard pneumatic and "Hicycle" electric grinders. In the table below are shown the results of tests on one of the grinders described above and a pneumatic machine of similar capacity. The power costs may naturally vary in accordance with the conditions under which the tools work, but the figures show the working superiority and economy of the electric machines.

A graph shows the comparative speed curves of the electric as compared with a pneumatic grinder at work. It will be seen that the speed of the electric machine varies only between 5000 and 4800 r.p.m. over a wide range of torque, whilst that of the pneumatic grinder drops slowly from 6000 to 5600 r.p.m. after which it decreases very rapidly as the torque rises.

Wheel size.	R.P.M.		Stock removed.	Stock output per hour.	Hours life.	Cost wheel lb.	Ratio wheel wear to metal removed.	Cost of power.
	Free.	Load.						
			lb.	lb.		pence.		pence.
Hicycle grinder, 6 by 1in. to 2⅜in. diameter	5200	4800	13½	2·7	4 hr. 59 min.	10·88	1·6	0·308
Pneumatic grinder, 6 by 1in. to 2 9/16in. diameter	5200	2700	5½	0·91	6 hr. 2 min.	28·9	1·23	1·5

An Improved Gas Producer

WE recently had an opportunity of inspecting an improved design of the "Brush-Koela" gas producer, made by the Brush Electrical Engineering Company, Ltd., for road vehicles, which was described in THE ENGINEER of December 8th, 1939. In the new design what is known as the "Duo-Draught" system has been adopted by which immediate starting is effected by cross draught and efficient combustion of the fuel is ensured by the up draught. The cross draught is only used for starting and is effected by a separate blast pipe at the side of the main air inlet, the nozzle of which projects through into the centre of the grate. The engine may be started either on petrol or gas, the latter if a hand or electric blower is fitted. In the first case, gas is in use and the petrol turned off within a minute, using only the cross-draught blast pipe or tuyere. Water cooling of the blast pipe is avoided by using a special silicon and carbon compound for the nozzle. The vehicle can be run on the gas thus generated until the fire has spread through the generator, when a change is made to the up-draught system by means of a two-way valve mounted on the top of the pre-heater. Then the water-drip is started so that superheated steam and air are fed through the pre-heater to hold the fire-bed temperature below the fusing temperature of the ash in the fuel, clinker formation by these means being avoided. A special steel grate, with vertical fire bars, is now hung from the upper rim so that air can circulate more freely about the entire grate. Production is at present concentrated on the output of a size particularly suited to vehicles with an unladen weight of 50 cwt. but we are informed that other types are to be made shortly.

Sixty Years Ago

THE TAY BRIDGE DISASTER

As we have previously remarked in this note, the disaster to the Tay Bridge on December 28th, 1879, called forth many comments and suggestions, technical and otherwise, some rational, many uninformed, and not a few foolish. Many sermons on the subject were preached in Scotland—some of them, to quote a contemporary opinion, being in "execrable taste." Among such sermons was one delivered by Dr. Begg, who took as his text a portion of the tenth verse of the ninth chapter of Isaiah: "The bricks have fallen down, but we will build with hewn stone." The sermon was printed and was read by the contractor who supplied the bricks used in the construction of the bridge. He expressed his views on it in an indignant letter, protesting that his bricks were of the very best quality. In any event, he added, it was the stonework and not the brickwork which had given way. . . . Our issue of January 16th, 1880, contained a selection of the numerous letters on the disaster which we had received from our readers. Some of them displayed a good deal of wisdom after the event. One correspondent said that a cross-section of the collapsed spans reminded him of a ship's mast with all the weather shrouds and backstays carried away, and suggested that the bridge ought to have been constructed with inclined struts extending from the upper flanges of the main girders to subsidiary piers spaced 40ft. out from the centre line of the bridge on each side. Another correspondent recalled the fact that just before the disaster there had been a severe frost followed by a thaw. He thought that a possible cause of the collapse might have been the contraction of the cast iron tubular pier columns on to the concrete with which they were filled, and the consequent splitting of the cast iron. He suggested that the columns instead of being filled with concrete should have been well drained and ventilated and given an occasional tarring inside to prevent corrosion. Mr. Hamilton W. Pendred of Salford demanded that the public should be informed as to the precise functions of Government inspectors of railway bridges and viaducts. Before the Tay Bridge was opened two Government officials spent three days inspecting it. Could two gentlemen, he asked, make a really efficient examination of such a large structure in such a short time? Did the Board of Trade exercise any censorship over the designs of railway bridges or could anyone erect a defectively designed bridge without let or hindrance from the Government? . . . In a leading article in the same issue we recorded that immediate steps were to be taken to rebuild the bridge and that the design for the new structure had already been prepared. The collapsed piers, we said, were to be rebuilt in brickwork set in cement with inclined struts extending from them to anchorages fixed above and below the bridge. We could not, we said, bring ourselves to believe that the proprietors of the bridge could have sanctioned such a scheme.

LICENSING OF IMPORTS REQUIRED.—The Board of Trade has been requested by the Government Purchasing Departments to emphasise to Government contractors and sub-contractors the importance of avoiding the importation of goods and machinery required by firms in connection with Government contracts where the equivalent can be obtained from British sources. In cases where Government contractors find it necessary to import goods on the Imports Prohibited List, they should as early as possible advise the Government Purchasing Department concerned, which will provide evidence regarding the contract; and this evidence should accompany the firm's application to the Import Licensing Department for an Import licence.

SCOPE IN WORKS MANAGEMENT.—"The Journal of Careers" is published monthly by Truman and Knightley, Ltd., of Conduit Street, W.1. As its title implies it deals with careers of all kinds, and in the January number of Volume XIX a series entitled "Choosing a Career in Engineering" is continued by Mr. H. T. Hildage, M.I.C.E., with an admirable article on "Scope in Works Management." The author begins by outlining the duties of the works manager, he then discusses what kind of man the works manager should be, very rightly stressing his ability to handle human beings, and ends up with some comments on training and employment. Attractively and clearly expressed, Mr. Hildage's views are well worth the consideration of all who look to works management as a career.

AN AIR COMPRESSOR MOUNTED ON A ROAD ROLLER.—In road work there are often cases where the use which could be made of a portable air compressor is not considered sufficient to warrant the expenditure on a plant. In order to enable the advantages of pneumatic plant to be obtained without incurring heavy expenditure an unusual equipment was recently supplied by Holman Brothers, Ltd., of Camborne. It consists of one of the company's standard two-stage air-cooled compressors mounted on an oil engined road roller. Drive to the compressor is effected by a sprocket and chain from the shaft on which a pulley for driving other plant is normally fitted. We are informed that, with the throttle of the engine about two-thirds open, the compressor delivers sufficient air to maintain a pressure of between 80 and 90 lb. per square inch.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer.

A Consolidation Export Order

The Board of Trade has made an Order entitled the Export of Goods (Control) Order, 1940, which came into force on January 15th, and which replaces the previous order and the various amending orders and open general licences issued with regard to it. It is pointed out that the new order is virtually a consolidation order and the revised schedule of goods requiring export licences is substantially the same in effect as the schedule now in force. The schedule, however, has been recast into convenient groups in order to facilitate reference, and the descriptions of particular items have been revised where experience has shown that exporters were in doubt as to what they covered. In general the new list shows the present practice of the Export Licensing Department to which exporters are accustomed, and it is necessary to call attention only to certain changes. Exporters can satisfy themselves about particular items by reference to a booklet which contains an alphabetical index and which is obtainable from the Export Licensing Department, Inveresk House, Strand, London, W.C.2. Any inquiries should be addressed to that Department or to the local Collector of Customs and Excise. It is important that it should be understood that existing licences already in the possession of exporters are not in any way invalidated by the new control order. There are, however, certain changes in detail which should be noted. Metals have been grouped under a heading which in most cases puts them and their alloys in all unwrought forms on to List A; whilst manganese and its alloys, and ores and concentrates of columbium and tantalum have been added to List A. Cemented carbide metal has been added to List B. Another alteration of importance to engineers is that instruments, tools, &c., including dies of diamond and metallic carbide, tools, and tool parts of which the cutting edge is tipped with metallic carbide or diamond and certain navigational time pieces have been added to List B. The Control on the export of ploughs has been relaxed; licences will only be required in the case of certain destinations (List B). The coal tar products and intermediates which require licences have now been listed separately by name; and compounds of tantalum, titanium, tungsten, and vanadium have been added to List A. A further announcement was made on January 14th that as from January 15th the section of the Export Licensing Department dealing with applications for licences in respect of iron and steel goods would be removed from 35, Old Queen Street, London, S.W.1, to Inveresk House, 346 Strand, W.C.2.

The Pig Iron Market

Consumers' requirements of pig iron appear to be growing rapidly and in some departments stringent conditions are noticeable. There is an exceedingly heavy demand for basic iron and although production has been pressed to its utmost the requirements of the steelworks are in excess of the material available. This, however, has not infrequently been the case in peace time when boom conditions developed in the steel industry and the steps then taken to supplement supplies will be a useful precedent for the Control in war time. It is known that good quantities have been arranged for and the position in this market does not give any real cause for anxiety. Business in foundry iron also is growing although irregularity in the working of the light castings foundries when the operations of the industry throughout the country are considered are responsible for the demand being much more active in some districts than in others. On the north east coast the supplies of No. 3 Cleveland foundry iron to the light castings foundries are largely delivered from stocks and the business passing is almost entirely of a prompt description. As the production of No. 3 Cleveland has been suspended supplies are naturally rendered rather short, and as a result many users are having to substitute silicon irons. The Control, however, has for some time been encouraging the use of Midland irons in this district, and considerable tonnages are now being taken up. In the Midlands the situation is satisfactory, and there have been no complaints that consumers have gone short of their requirements. It is suggested that this is largely due to the way in which the Control regulates the distribution. There are little in the way of stocks at the consumers' works, but the policy of the authorities seems to be to discourage the holding of pig iron by users. Engineering foundries in the Midlands have as much work on hand as they can manage, and are large consumers of low phosphoric foundry irons. In this district a fair number of the light castings makers are engaged upon war work and as a consequence the demand for high phosphoric pig iron has appreciably increased. In other directions the demand for castings usually produced by this section of the industry has noticeably declined. In Scotland, on the other hand, the foundries making light castings are irregularly employed and seem to find it difficult to work full time. As a result the call for Scottish foundry iron is intermittent. Business in hematite is active and the stocks have been materially reduced. Production, however, appears to be increasing and there is no real stringency in this department.

The Midlands and South Wales

The flow of steel from the producing works to consumers is reaching enormous proportions, but even so it is not sufficient to meet fully the demands of all consumers. Excepting for an insignificant tonnage the whole output is going into consumption upon work arising from war requirements, either directly or indirectly. There is a tendency generally for deliveries to fall into arrears in spite of the great care with which distribution is regulated by the Iron and Steel Control. The strain is more noticeable in some departments than in others, and perhaps is most acute in the semi-finished steel department, in which home production is insufficient to meet the demands of consumers. The position, however, has been improved to some extent during recent weeks by the distribution of imported semis, and it is expected that further relief will be afforded by increased imports from abroad during the coming weeks. As it is, many of the re-rollers have received sufficient supplies to enable them to operate nearly at capacity. The position in this branch of the industry, therefore, is more satisfactory than for some time since the works can now make some inroads upon the great accumulation of orders upon their books. The demand for small sizes of bars and structural steel shows no signs of diminishing and most of the re-rolling firms have sufficient work in hand to keep them fully employed for months. The demand for plates is particularly heavy and not only are large tonnages passing to the shipyards, but the locomotive, tank, and boiler makers are all busy and are pressing to secure deliveries, whilst endeavouring in some cases to accelerate them. The plate mills have little room for fresh orders as they are booked to capacity for a long time to come. In the structural steel department the situation is unchanged. The demand is phenomenal, and the works in spite of the pressure under which the material is turned out are unable to keep abreast of the demand. The constructional engineers are mostly employed upon big engineering contracts, and the shipyards are working at capacity and are absorbing enormous tonnages. In South Wales the steelworks are all operating at capacity and the demand from the shipyards, ship repairers and constructional engineers seems to be growing rather than slackening. The steelmakers in fact would be glad of some breathing space to overtake some of their arrears. The tinplate works are in a very comfortable position and have orders for upwards of eleven million boxes on their books. Their chief pre-occupation is the tightness in the supply of sheet and tinplate bars, but this, it is said, will be relieved shortly by foreign imports. There is a strong overseas demand for tinplates which keeps the price steady at about 32s. f.o.b. 20 by 14 basis, in contrast to the home trade quotation of 21s. 6d. f.o.t. makers' works.

Scotland and the North

All departments of the Scottish steelworks are fully employed and have a big reserve of orders on their books. The shipbuilding and constructional engineers continue to take up almost unprecedented supplies of structural steel. All the yards on the Clyde are as busy as they can be, and the constructional engineers almost without exception are employed upon important Government contracts. Consumers continue to press for deliveries against contracts already placed and to secure the acceptance of new orders. The congestion at the steelworks, however, is so great that the makers are disinclined to take new business unless it is required for urgent Government work. This point, however, does not have much influence upon the situation since such a large proportion of the orders coming forward are directly or indirectly for Government purposes and come within the priority categories. The recent accession of orders to the locomotive works has caused another rush of business in steel material, including plates. Most consumers of this class of material are busy and there is a big demand from the tank and boiler makers. The semi-finished steel position has improved of late as a result of imports of fair quantities of foreign material and it is understood that arrangements have been made which will maintain the supply. In this malleable iron section of the market the works are in a more satisfactory position as regards orders in hand than for many months. The demand for small sizes of best iron bars, common bars, and strip is strong, and although plant is not so fully engaged as in some other sections of the trade, employment is on a good scale and is growing. The re-rollers in Scotland continue to produce as nearly to capacity as supplies of semis will permit and in many cases they are unable to accept fresh business except for far forward delivery. The quantities of small angles and sections required for A.R.P. purposes has diminished during the past few weeks, but there is an active business passing in sections and bars for other purposes. In the Lancashire steel market conditions have not materially changed, and consumers are exerting great pressure to obtain supplies of all classes of steel. The engineering works in this district are fully employed upon Government orders and their requirements are heavy. There is a vigorous demand also for special and alloy steels which is assuming large proportions. Sufficient work is in the hands of the boiler and tank making establishments to ensure full employment during the whole of 1940. New business in sections has declined somewhat of late, largely from seasonal causes, but most of the works had large orders for this material in hand and it is expected that the demand will again make itself felt in the not distant future.

Copper and Tin

The heavy requirements of the copper consuming industries are fully maintained, and some observers believe that they are expanding. In the absence of an open market such as was provided by the London Metal Exchange, it is however impossible to follow closely the upward and downward swing of the demand. So far there does not appear to have been any appreciable advance in the negotiations which the London Metal Exchange has been carrying on with the Ministry of Supply with the object of reopening the market, or in an arrangement by which merchants, who are doing a considerable trade, may secure any remuneration for their activities. It is high time that the Ministry of Supply addressed itself to these problems which should not be insoluble, provided the Ministry showed a willingness to consider the position of the private trader. The Control does its work of supplying the needs of the war industries, but there does not seem to be any great surplus of prompt metal. This is indicated by an intimation when licences are granted that the Control cannot accept responsibility for delivery on the date mentioned in the licence. There is very little export business passing, but this is scarcely to be wondered at considering the necessity of first meeting the home demands. Opportunities are also lost of merchants doing a trade between American producers and neutral countries. A little business of this description is passing, but probably it could be greatly expanded if facilities were afforded by the authorities, and it seems a pity that the chance has not been taken of thus adding to our exchange balances abroad. It is also pointed out that if the London Metal Exchange were permitted to resume trading it would lead to foreign business in the way of hedging operations. In the United States there has been an active inquiry from neutrals, including Italy, Japan, and Russia, but the latter country appears to have great difficulty in obtaining the metal she requires. . . . The tin market has presented no particular features, but the tone has been more resilient than of late. This may be due partly to the purchase by the United States Government of 500 tons of tin for delivery in July. It is generally thought that supplies of tin are if anything in excess of requirements and there is a belief that the present total prohibition of exports will be modified. It is suggested that as tin is not used for war purposes in such large quantities as other non-ferrous metals this could be done without inconveniencing this country. On the other hand the stocks in Great Britain are not excessive and it may be that the authorities desire to see them raised to higher figures as a precaution before neutral consumers are given an opportunity of accumulating reserves.

Lead and Spelter

Large quantities of lead continue to pass into consumption upon war work, and although so far as can be gathered all consumers engaged upon Government contracts receive the metal they require, there does not seem a great surplus of prompt metal. Lately there has been some agitation to impress upon the authorities the need for stimulating the building industry. If this were done it would probably lead to an additional demand for lead which it would not be in the public interest to satisfy whilst supplies are so urgently needed for national purposes. No statistics are being issued of supplies, but apparently the quantities which are available from Empire sources are sufficient to meet this country's war requirements. So far as can be gathered the world market is not receiving more lead than is necessary, and the chief source of supply would appear to be Mexico. The general view is that the demand from neutral sources is likely to expand this year, and at the same time there is considerable speculation as to whether Empire supplies will be sufficient for our own requirements notwithstanding the satisfactory way in which hitherto the consuming works in this country have been receiving metal. In the American market the demand has shown signs of dwindling, but this is probably because in the latter part of 1939 consumers covered their forward requirements on a liberal scale. Producers in the United States show no uneasiness as to the position, and are reported to have a good reserve of orders on their books. The industries consuming spelter are working at high pressure and considerable quantities of the metal are being used. The galvanising industry is still fully employed and is taking considerable quantities, whilst the brassmakers are also exceedingly busy and are understood to be working at capacity. Firms which have attempted to do an export business in articles in the manufacture of which spelter plays a part find that there is little available for this purpose. Manufacturers are prepared to quote for overseas destinations but without any guarantee as to the delivery and usually with an intimation that it will be a long time before the orders can be executed. There is also a scarcity of hard spelter for export; and India, which is usually supplied from this country, is now reported to be seeking metal in other markets. In the United States the spelter market appears to be settling down at around present levels, but production is apparently in excess of the demand, and it is probable that the stocks are being added to.

MOULDS MADE BY ELECTRO-DEPOSITION.—The United States Rubber Company has evolved a process for the forming of moulds and dies electrically. By this process pure iron is deposited from an electro-plating solution directly on the surfaces of the pattern which is first rendered conducting by means of graphite. The die or mould is built up to any required thickness and then backed if necessary. It is claimed that the electro-formed iron is 99·98 per cent. pure, and about 50 per cent. harder than cold rolled steel.

MINE TUB BACK STAYS.—In order to prevent tubs or sets of tubs from running away when they get out of control on inclines in mines, a device known as a back stay, or drag, is used. This consists of a strong steel bar attached at the back end of the tubs and long enough to trail along the haulage track behind the tubs as they travel forward; if, however, they start to run back, the trailing end of the bar, which is often pointed or forked for the purpose, should immediately dig into the track and so stop the tubs. In practice, however, the back stays now used are not always effective in stopping and holding the tubs, and the Safety in Mines Research Board has made an investigation into the chief causes of such failures and the ways and means of preventing them by improving the design of the back stay. A paper has now been published making available to the coal mining industry the results of this investigation. The paper makes a critical examination of the types of back stays which are more commonly used, and it sets out the requirements for more effective design. The chief matters which require attention are, the use of suitable material, the length, weight, and cross-section of the back stay and the method and point of its attachment behind the tub.

French Engineering Notes

(From our own Correspondent in Paris)

Engineering Exports

Now that armament production is proceeding smoothly without the need of sacrificing everything to it, as was the case during the work of organisation, more attention is given to the necessity of manufacturing goods for export. Before the war imports had for a long time been limited by quotas, which were regarded as a temporary expedient to meet special conditions, but they had a prejudicial effect on the export trade, and efforts were therefore made to enter into reciprocal trade agreements with other countries. These agreements were not always satisfactory through failure of contracting countries to fulfil their obligations. There is now to be a less rigid system suggested by the economic arrangement with Great Britain which, it is supposed, may be extended to other countries for a development of wider international exchanges. But they will always be exchanges in the strict sense of the word. In principle, the old policy of freely exchanging goods and products between countries that are dependent on each other is no longer possible now that industrialism has spread so far and wide, and continues to gather impetus under conditions that bring to everyone a consciousness of the power of industry. There is fear that after the war much of this industrial potential will be useless unless it can be employed to better advantage by bringing manufacturing industries into a sort of international commercial collaboration, in which each country will have its special products for export. There are many essentially French exporting industries that, in normal times, find markets all over the world, but mechanical engineering has not yet acquired this characteristic national identity, although it is well on the way to do so. Modern mechanical engineering developed along lines parallel to those of foreign countries that supplied this market with machines, and French makers are departing from the originals in details as well as in design, and methods and practice have been introduced that are tending to this national character of machinery. The mechanical engineering industry must export. Makers of machine tools and agricultural engineers aim at organising the home market for themselves and increasing their production for sale abroad. The home market is too small for the economical manufacture of some machines. Claims for special protection to aid industry to develop in this way are opposed by a State policy which has abandoned the idea of self-sufficiency, except to the extent of achieving it as much as possible by a full utilisation of Empire resources. It has been repeatedly affirmed officially that the national economy suffers from an excessive protection of industries that cannot exist without it, and that such industries must be left to their fate. This line of policy is accepted as inevitable in order to derive the greatest benefit from new conditions of international trade based upon a wider system of reciprocity. The interests of engineering industries will be preserved so far as they do not clash with the general interest, which means that those branches of engineering production which can export will be favoured in international trade arrangements at the expense of others that can only be kept going by protection to the detriment of foreign trade.

Empire Raw Materials

Since armament demands for raw materials brought into prominence the necessity of taking the fullest advantage of supplies from overseas' possessions, the work undertaken to exploit their resources has been accelerated and some satisfactory results have been obtained. In the colonies the nickel supplies from New Caledonia are alone of interest to the metallurgical industries. Coal from Tonkin failed to find a stable market in France on account mainly of high freights, and in time of war it would be practically unobtainable. Madagascar is highly mineralised, but it produces little of interest to the metallurgist. Whatever may come of researches that continue to be made in the colonies, the present supplies of minerals and metals, apart from nickel, lack interest for metallurgical production. On the other hand, the department of Algeria and the protectorates of Tunis and Morocco make useful contributions of iron ore and coal, and in Morocco there are, besides, manganese, cobalt, lead, zinc, tin, and molybden. Before the war the mother country had to impose restrictions on imports from North Africa, and this had the effect of slowing down enterprise, particularly in Morocco, which was obliged to depend upon foreign markets for the sale of its products. The situation has now changed, and the North African products are needed in France. Recently, arrangements were made, at the instigation of the Minister of Public Works, to accelerate production. More coal is to be supplied by the Djeradda and Kanadsa collieries, for which purpose a railway is to be constructed in the desert to the south of Algeria to connect up the latter colliery with the Algerian railway system. Morocco is expected to become an important supplier of coal and minerals to France.

The West Motor Road

While all public works were temporarily held up at the mobilisation they are not to be allowed to remain in that state. With a considerably reduced number of workers they are still making headway. The construction of the West Motor Road that starts from Saint-Cloud, and branches out to the national roads in the directions of Normandy and the south-west, is being continued with one fifth of the number of men formerly employed upon it. There are two important works at the Saint-Cloud end, one being a tunnel through which the road passes and the other the construction of a wider skew bridge across the Seine from the axis of the old bridge on the Paris side, the object of the displacement at the Saint-Cloud end being to facilitate traffic up a gradient to the tunnel. This tunnel passes through the heights of Saint-Cloud and is 980ft. long, 50ft. high, and 55ft. 9in. wide. For about 300ft. the tunnel had to be built on reinforced concrete piles driven through sand to a depth of 39ft. Public works are being accelerated by a selection and training of labour, as well as by the releasing from active service of older classes that will provide more men as time goes on.

British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

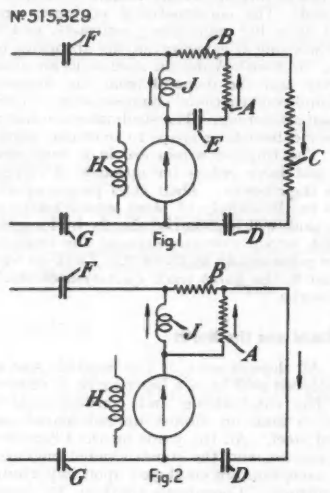
Copies of Specifications may be obtained at the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS

515,329. June 17th, 1938.—RHEOSTATIC BRAKING OF ELECTRIC MOTORS, Arthur Mandl, of 60, Westbourne Road, Sheffield, 10, and Metropolitan-Vickers Electrical Company, Ltd., of 1, Kingsway, London, W.C.2.

This invention has for its object to provide an improved arrangement of electrical circuits in which a compound-wound electric motor is connected for the purpose of obtaining rheostatic braking. In Fig. 1 the diverter resistance for the series field winding is shown at A, the resistance in series with the field winding at B, and the main rheostat braking resistance at C. Braking switches are indicated at D and E. For motoring the switches F and G are closed and a current is supplied to the shunt field winding H. For braking the switches F and G are opened and the switches D and E closed. It will be observed

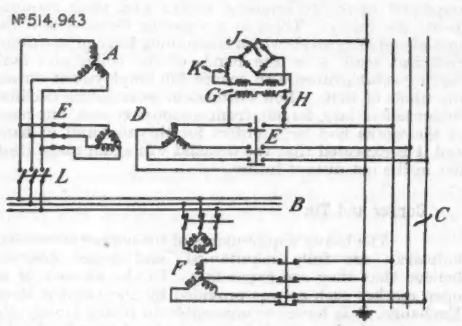


that the current through the series field winding J which also flows through the series resistance B is reduced by reason of the diverter resistance A. The total resistance of the series field winding J and the resistances A and B is, however, considerable so that the damping effect of this closed circuit is very much reduced. Referring now to Fig. 2, the resistance C is omitted and the values of the resistances A and B are increased so that during braking the arrangement will give identical static characteristics as would that shown in Fig. 1. The resistances A and B will then be so high relative to the resistance of the series field winding J that these two resistances may be left permanently in circuit during motoring without making any appreciable difference to the motoring characteristics. The switch E can consequently be dispensed with, and a single braking switch D be employed, which is closed during braking and open during motoring when the switches F and G are closed.—*December 1st*, 1939.

ELECTRICAL APPLIANCES

514,943. April 20th, 1938.—MEANS FOR SYNCHRONISING SINGLE OR POLYPHASE ALTERNATING CURRENT SYSTEMS, Jack Robert Perry, of 31, Cromer Road, Norwich, Norfolk.

This invention relates to means for synchronising single or polyphase alternating current systems wherein the systems are electrically coupled through inductors of variable impedance, the impedance being adjusted to a high value originally and being decreased gradually until the systems are in phase. In the arrangement shown an alternator A, which is to be synchronised with a high tension bus bar system B, is adapted to be coupled to a low tension three-phase four-wire house bus bar system C through a star-delta synchronising transformer D, a fuse group E and a circuit breaker. The low tension house bus bars are fed from the high tension bus bars through a transformer F.



The choke windings of an inductor G are connected in series with a switch H and the saturating windings of the inductor derive their power from a full wave rectifier circuit J connected between the neutral house bus bar and the side of the switch adjacent to the inductor. The current flowing through the saturating windings is manually controlled by means of a rheostat K. In operation the alternator is run up to speed and excited. The control rheostat is adjusted to the maximum value and the phase voltage of the low tension house bus bars is applied to the rectifier circuit by closing the switch H. Further, the inductor G is connected in series with one phase of the low voltage side of the synchronising transformer when this switch is closed and the single phase voltage of the low voltage house bus bar system is applied across the series circuit so formed. Thus, power may be fed to the alternator through one phase of the synchronising transformer. Alternatively a single phase synchronising transformer may be used. The resistance of the rheostat K is thus decreased gradually until the alternator runs in synchronism with the high tension system, when a circuit breaker L is closed to couple the alternator to this system. It will be appreciated that any suitable low voltage alternating potential may be applied to the rectifier circuit.—*November 22nd*, 1939.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Bradford Engineering Society

Monday, Jan. 22nd.—Technical College, Bradford. "Repairs by Welding," H. Moss. 7.30 p.m.

Institution of Civil Engineers

Thursday, Jan. 25th.—Yorks. Association. Hotel Metropole, Leeds. Annual Dinner. 6.45 p.m. for 7 p.m.

Institution of Electrical Engineers

Monday, Jan. 22nd.—South Midland Centre. James Watt Memorial Institute, Great Charles Street, Birmingham. "Electricity and Civilisation," H. Joseph. 6 p.m.

Tuesday, Jan. 23rd.—Scottish Centre. Royal Technical College Glasgow, C.1. Chairman's Address, S. Parker Smith. 6.30 p.m.

Thursday, Jan. 25th.—Savoy Place, Victoria Embankment, W.C.2. "Fire-Fighting Equipment for Electrical Installations," H. W. Swann, J. Hacking, and R. A. McMahon. 6 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tuesday, Jan. 23rd.—39, Elmbank Crescent, Glasgow. "Effect on the Propulsion of a Single-Screw Cargo Vessel of Changes in the Shape and Dimensions of the Propeller," J. L. Kent and R. S. Cutland. 6.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 19th.—Storey's Gate, Westminster, S.W.1. Hawksley Lecture. "A Review of Forty Years' Development in Mechanical Engineering Plant for Power Stations," Sir Leonard Pearce. 3 p.m.

Institution of Production Engineers

Tuesday, Jan. 23rd.—Mostyn Hotel, Portman Square, W.1. "The Use of X-Rays in Inspection Methods," G. E. Bell, and "Inspection by Optical Projectors," W. G. Ridge. 7.30 p.m.

Saturday, Jan. 27th. Yorks. Section. Hotel Metropole, Leeds. "Grinding Wheels," A. Pearson. 2.30 p.m.

Junior Institution of Engineers

Saturday, Jan. 20th.—Midland Section. James Watt Memorial Institute, Birmingham. "Recent Developments in the Use of Town's Gas and other Gases for Traction Purposes," C. M. Walter. 2.30 p.m.

Friday, Jan. 26th.—39, Victoria Street, S.W.1. "The Advantages accruing to Forced Circulation Boilers," R. E. Trevithick. 6.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Friday, Jan. 26th. Mining Institute, Newcastle-upon-Tyne. "Propulsion Scale Effect," W. P. A. van Lammeren. 6 p.m.

Wednesday, Jan. 24th.—Student Section. Bolbec Hall, Newcastle-upon-Tyne. "Steam Turbines for Merchant Ships," J. E. S. Fraser-Smith and P. J. Daglish. 6.45 p.m.

Royal Institution of Great Britain

Wednesday, Jan. 24th. 21, Albemarle Street, W.1. "Theory of Nuclear Forces," R. Peierls. 5.15 p.m.

Friday, Jan. 26th. 21, Albemarle Street, W.1. "Long Distance Broadcasting," Sir Noel Ashbridge. 5 p.m.

Royal Society of Arts

Wednesday, Jan. 31st.—John Street, Adelphi, W.C.2. "Architecture—1919 to 1939," H. Robertson. 2.30 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS

THE ATLAS DIESEL COMPANY, Ltd., has changed its address to Beresford Avenue, Wembley, Middlesex.

HOLMAN BROS., Ltd., Camborne, inform us that the address of their South Wales Branch Office is now 210, Cyncoed Road, Cardiff. Mr. W. D. Rule remains in charge of the Branch.

MR. R. T. Hood, formerly chief Scottish Sales Representative for British Timken, Ltd., Cheston Road, Aston, Birmingham, 7, has been appointed Chief of the Mechanical Engineering Department of the Company.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Ltd., Loughborough, informs us that Captain Richard C. Petter, M.I. Mech. E., and Mr. Charles L. Hill have been elected to the Board of the Company.

MR. W. R. BLAIR, M.C., LL.B., has accepted office as Director of the Ironfounders' National Committee, and entered on his new duties at the beginning of the year. His office is at Orchard House, Orchard Street, W.1.

SULLIVAN MACHINERY COMPANY, Ltd., announces the incorporation on December 22nd, 1939, of a Limited Liability Company taking over the sales, assets, and liabilities of Sullivan Machinery Company, Grantham. Mr. F. A. Bird is Managing Director and the business will continue to be carried on from Grange Works, Grantham.

CATALOGUES

DARWINS, Ltd., Sheffield.—Pamphlet "Cobalterom" Air-Hardening Tool Steel.

HADFIELDS, Ltd., Sheffield.—Pamphlet No. 436. "Era H. R." Heat Resisting Steels.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Pamphlet P.F. 353—Fire Resisting Insulated Cables.

GENERAL ELECTRIC COMPANY, Ltd., London.—Leaflet 8925—Switchgear for Lighting Services in Air Raid Shelters.

CONSOLIDATED PNEUMATIC TOOL COMPANY, Ltd., London.—Catalogue No. 49—Two-stage air-cooled and single-stage water-cooled vertical power-driven compressors.

HOWARD GRAHAM, Ltd., Tiddington Road, Stratford-on-Avon.—Catalogue illustrating and describing the construction, operation, and applications of "Harris" flexible bearings and shackle assemblies.